DOCUMENT RESUME

ED 282 026 CE 047 121

AUTHOR Prickett, Charlotte
TITLE Electronics Curriculum.
INSTITUTION Northern Arizona Univ., Flagstaff. Center for Vocational Education.
SPONS AGENCY Arizona Occupational Research Coordinating Unit, Phoenix.
PUB DATE Aug 86
NOTE 206p.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC09 Plus Postage.
DESCRIPTORS *Electrical Occupations; *Electromechanical Technology; Electronics; *Electronics Industry; *Electronic Technicians; Job Analysis; *Job Skills; Occupational Information; Postsecondary Education; Secondary Education; *Trade and Industrial Education

ABSTRACT

This document presents results of research conducted by industry representatives regarding tasks performed by electronic technicians and line manufacturing electro-mechanical technicians in Arizona electronics industries. Based on this research, a competency-based curriculum was developed for training entry-level electronics technicians. Twelve major areas of tasks are identified: basic skills, analog, digital, safety, hygiene, optics, programmable controllers, pneumatic controls, hydraulic controls, physical skills, personality skills, and troubleshooting. For each area, major competencies and detailed tasks are presented. A separate page provides this information for each task: competency, task, standard of performance, source of standard, conditions for performance of task, and a performance guide. The task, standard, conditions and guide, when used together, are intended to form a performance objective. Appendixes include a listing of resources, equipment lists, and a complete summary of competencies and tasks. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED282029

ELECTRONICS

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

ARIZONA DEPARTMENT OF EDUCATION
CAROLYN WARNER, Superintendent
DR. JIM HARTGRAVES, Deputy Superintendent
JOHN LANGE, Deputy Superintendent,
State Director for Vocational Education

ARIZONA CENTER FOR VOCATIONAL EDUCATION
CENTER FOR EXCELLENCE IN EDUCATION
NORTHERN ARIZONA UNIVERSITY

AUGUST 1986

ELECTRONICS CURRICULUM

BY

CHARLOTTE PRICKETT
PROJECT DIRECTOR

ARIZONA CENTER FOR VOCATIONAL EDUCATION
CENTER FOR EXCELLENCE IN EDUCATION
NORTHERN ARIZONA UNIVERSITY
FLAGSTAFF, ARIZONA 86011

September, 1985

BEST COPY AVAILABLE

ARIZONA DEPARTMENT OF EDUCATION

Carolyn Warner, Superintendent

Deputy Superintendent
Dr. Jim Hartgraves

Vocational Education Division
Mr. John T. Lange
Deputy Superintendent
for Vocational Education

Education Services Division
Mr. David L. Tate
Associate Superintendent

General Operations Division
Mr. James J. Brunstein
Associate Superintendent

STATE BOARD OF EDUCATION

STATE BOARD OF VOCATIONAL EDUCATION

Eddie Basha ..... President
Tom Espinoza ..... Vice President
Honorable Carolyn Warner ..... Executive Officer
C. Diane Bishop ..... Member
Nolan Blake ..... Member
Ray Borane ..... Member
Dr. Eugene M. Hughes ..... Member
Betty Inman Lee ..... Member
Karin Kirksey Zander ..... Member

FUNDING INFORMATION

Project Title: Electronics Curriculum

Educational Act Under Which the Funds Were Administered: Education Amendments of 1976, P.L. 94-482

Source of Grant: Arizona Department of Education
Phoenix, Arizona

Grantee: Arizona Center for Vocational Education
Center for Excellence in Education
Northern Arizona University
Flagstaff, Arizona 86011

Disclaimer: This publication was prepared pursuant to a grant from the Research Coordinating Unit, Arizona Department of Education. Grantees undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official Arizona Department of Education position or policy.

Discrimination Prohibited: Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." Therefore, the Arizona Center for Vocational Education Project, like every program or activity receiving assistance from the Arizona Department of Education, must operate in compliance with these laws.

Printed by the
Arizona Center for Vocational Education
Flagstaff, Arizona
Total Copies Printed: 100 Unit Printing Cost: $12.58
Total Printing Cost: $1,257.81 Date of Printing: September, 1985
On behalf of the
Arizona Department of Education

FOREWORD

The Electronics Curriculum project was funded to provide direction for electronics programs at both the secondary and the postsecondary education levels for vocationa/technical students in Arizona. Impetus for the project originated from research completed by an Industrial Task Force comprised of representatives from Arizona electronics corporations. It further utilized a recent study which related mathematics competencies to electronics competencies. We hope that these materials will be both helpful and meaningful to Arizona educators, community members and students.

ACKNOWLEDGMENTS

In the development of this document the contributions of the following individuals were greatly appreciated:

Writing Team

Dr. Roger A. Mussell, William Rainey Harper Col., Palantine, IL
Dr. Richard Bernstein, William Rainey Harper Col., Palantine, IL
Renault Catalano, Glendale Community College, Glendale, AZ
Robert Cullifoer, Mesa Vo-Tech, Mesa, AZ
Roy Harrington, Deer Valley High School, Glendale, AZ
Ron Moody, Pima Community College, Tucson, AZ
Charles Parnell, Eastern Arizona College, Thatcher, AZ
Rick Peters, Eastern Arizona College, Thatcher, AZ

Industrial Task Force Members

Tom DeShong, National Semiconductor
Ed Petrosky, National Semiconductor
Tom Orton, Intel
Len Wright, Honeywell
Ed Dispain, Honeywell
Murry Allen, Motorola

Project Consultants

Dr. Barbara Gutheil, Arizona Center for Vocational Education
Charlotte Prickett, Arizona Center for Vocational Education
Dr. Linda Loomis, Arizona Center for Vocational Education

In addition, we are grateful to Kathy Dunn for her leadership and assistance in getting the final curriculum guide edited and printed.

Don Parsons, Manager
Arizona Center for Vocational Education

Dr. Robert V. Kerwood, Director
Arizona Center for Vocational Education

EXECUTIVE SUMMARY

This document presents the results of current research conducted by industry representatives regarding tasks needed by electronic technicians and line manufacturing electro-mechanical technicians in Arizona electronics industries. The purpose of this document was to take the research findings from the industry study and develop curriculum components which would be helpful to educators who are involved in making curriculum decisions in electronics. For each of the major areas identified by industry research, major competencies and then detailed tasks were developed. Standards of performance of the tasks were written to specify criteria for assessment of the task. Then, materials, environment, supplies, and equipment were recorded to provide conditions for the performance of each task. The task, standard and condition when used together form a performance objective. These performance objectives will service as a foundation for teachers as they develop learning activities and criterion referenced evaluation instruments for their programs.

INTRODUCTION

The Curriculum Academy for Electronics major focus is to create an overall strategy for training entry level technicians in automated manufacturing positions for the Electronics Industries in Arizona. The Curriculum Academy electronics group was charged with the responsibility for developing a pedagogically sound competency-based training program utilizing three sources of expertise:

1) Bring together a select group of high school, community college teachers and consultants to work out a competency-based approach to teaching automation skills;
2) Utilize research completed by an Industrial Task Force comprised of representatives from four Arizona corporations: Honeywell, Intel, Motorola and National Semiconductor. The report is titled "Date for Public School Curriculum Development: An Electronics Industry Skills Analysis for Educational Objectives", and
3) Utilize a research report dealing with the relationship of mathematics competencies vs. Electronics competencies. The report is titled "Electronics Curriculum Planning Guide for the 1980's and 1990's".

This report summarizes the process of developing the training guides, as well as the direction, intent and rigor of this guide. In addition, the specific competencies and tasks are identified and the level at which they can be taught: either secondary, postsecondary or both.

Industry Task Force

The Industry Task Force was formed in 1983 in response to a perceived need to develop industry-oriented training programs in electronics. The participating companies were Honeywell, Intel, Motorola and National Semiconductor. The purpose of the task force was to define criteria to be used to establish a training program for technicians entering the field of Electronics in the automated manufacturing area.

The major obstacles the task force had to overcome were consensus on a method to obtain significant data and identification of commonality of technician jobs. Each company has a different classification system for technicians. The solution which was agreed to was the use of the Position Analysis Questionnaire (PAQ). The PAQ is a structured questionnaire used to obtain job analysis information. Six areas are integrated to define job characteristics: information input, mental processes, work output, interpersonal skills, job context, and other job

characteristics. Many jobs can be analyzed with the PAQ. Yet, it is not intended as a substitute for applications best served by traditional job analysis. The PAQ is distributed through Purdue University Bookstore, West Lafayette, Indiana.

Through the use of the PAQ, and interviews with over three hundred technicians, the industry task force condensed twenty-one different job titles into two:

1. Electronic Technican
2. Line Manufacturing Electromechanical Technician

These two job categories focus on the technician in automation. Industry task force recommendations were also included in development of the curriculum planning guide.

Direction and Interest

The academy direction and intent emanated from two sources:

1) The Industry Task Force report, and
2) The goals of the academy and academy participants.

The training program direction was established by industry's focus on automation and the educators' focus on the relationship of mathematics to electronics competencies. Industry is looking for a technician with a broad knowledge base encompassing the following topics:

Analog Electronics
Digital Electronics
Safety
Hygiene
Optics
Programmable Controllers
Pneumatics
Hydraulics
Personality Skills
Physical Skills
Troubleshooting Skills

Cross training and the ability to do more than one job are also a critical concern.

The curriculum goals of the academy were threefold: First, to examine closely the data from the Electronics Curriculum Planning Guide for the 1980's and 1990's, and correlate and expand specific tasks into selected grouping for teaching. Second, to use the results of the Industry Task Force study in developing a realistic training guide. Third, to use the academy group process to accomplish two tasks: To organize and draft a pedagogically sound curriculum planning guide that would meet the needs of industry; and draft a matrix indicating competencies and tasks that can be taught at secondary and postsecondary levels of instruction.

The academy participants reached consensus on several key issues:

1. The training program focus is on Automated Manufacturing Technician Training for entry level positions in the electronic industries.

2. The curriculum guide does not represent a course of study, but a collection of competencies and tasks necessary to meet the job requirements outlined by industry. The implementation and integration of these competencies is the responsibility of the institution providing the training.

3. The matrix clearly identifies which competencies and tasks can be taught at the secondary level. However, due to upgrading and retraining of adult populations the entire program may need to be offered at the postsecondary level, while selected competencies and tasks are offered at the secondary level.

4. This curriculum includes a nontraditional aspect of job training which was deemed a key training component: A strong emphasis on personality and physical skills required by persons on the job.

5. The curriculum guide represents a new variation on the teaching of Electronics, not a total restructuring of Electronics Technician training programs in Arizona.

Competency Rigor

Mathematics is the key factor in determination of the level to which the competency and appropriate task are taught. Data obtained from the Industry Task Force study indicated the math rigor for this entry level technician is algebra and geometry. The academy participants concurred, but added enough trigonometry to teach tasks relating to phasor analysis. The Electronics Curriculum Planning Guide for the 1980's and 1990's addressed this issue and clearly determined that the level of mathematics taught establishes the level of rigor. This was shown through the analysis of two jobs: the Electronic Engineering Technician and the Electronic Assembler.

Next Steps

The curriculum academy has successfully created an overall strategy for training entry level technicians for automated manufacturing positions in the Electronics Industries of Arizona. The next steps are important to continue the development and delivery of training program guidelines. The next step is to

place in appropriate positions, persons who have been through training which used the materials, direction and guidelines developed within this curriculum academy format. The specific steps recommended by the consultants are:

1. Identify cooperating high schools and community colleges.

2. Plan teacher training to provide orientation to concepts and pedagogy, project background, and philosophy.

3. Review selected manufacturers' training materials and assign materials as specific references to specific competencies and tasks.

4. Identify traditional and nontraditional laboratory equipment to teach each competency.

5. Meet periodically with the Industry Task Force to coordinate use of resources and equipment loan or gifts, and teachers training needs.

6. Develop plans for teacher exchange in the factories for summer work.

7. Develop courses for teacher retraining and upgrading at a state teacher training institution. Focus on the integration of personality and physical skills with other topics not traditionally taught in Electronics Technician training programs.

These seven steps, when successfully completed, will assure Arizona Electronics Industries a graduate with necessary entry level skills and competencies.

TABLE OF CONTENTS

FUNDING INFORMATION i

FOREWORD ii

EXECUTIVE SUMMARY iii

INTRODUCTION iv

BASIC SKILLS
1 - Operates Keyboard devices 1
2 - Apply math skills to solve problems 4
3 - Demonstrate written and verbal communication skills .. 7
4 - Demonstrate reading comprehension skills 9
5 - Know basic concepts of automated technology 10

ANALOG
1 - Evaluate, analyze and apply circuit theorems and laws to resistive electrical circuits using general mathematics 14
2 - Evaluate and analyze electric circuits using right triangle trigonometry 18
3 - Evaluate and analyze electric circuits using phasor algebra 20
4 - Measure circuit gain, frequency response and determine power dissipation of active circuits or subsystems ... 22
5 - Write technical reports documenting corrective action procedures 25
6 - Sketch schematics and pictorials of circuit layouts and test setups 27
7 - Construct circuits, sub-assemblies and systems from schematics, pictorials, wire and component lists 29
8 - Audit product performance by using production change orders and test specification sheets 32
9 - Classify component quality by measuring their physical and electrical properties 33
10 - Identify active circuit configurations 37
11 - Analyze devices using manufacturers' data sheets 38
12 - Use power sources and grounding techniques to ensure proper system performance 40

DIGITAL
1 - Analyze combinatorial logic circuits 44
2 - Analyze sequential logic circuits 48
3 - Analyze microprocessor-based logic circuits 53
4 - Analyze peripheral devices 59
5 - Test and measure digital logic circuits 61
6 - Program a dedicated wordprocessor 64

SAFETY
1 - Observes and follows personal and plant safety requirements 67

HYGIENE
1 - Follows personal hygiene practices for working in industry 89
2 - Knows hygiene requirements of the working environments in the Electronics Industry 92

OPTICS
Physical
1 - Uses Physical Optics to perform alignment of electromechniacal - optical systems 98
Geometric
2 - Use geometric optics to perform servicing and alignment procedures on automated test equipment 99
Lasers
3 - Use laser to perform selected industrial manufacturing processes 102
Fiber
4 - Troubleshoot fiber optic control systems 106

PROGRAMMABLE CONTROLLERS
1 - Assemble, test and troubleshoot programmable controllers, and associated input/output devices 108

PNEUMATIC CONTROLS
1 - Assemble, test and troubleshoot pneumatic control components and systems 112

HYDRAULIC CONTROLS
1 - Troubleshoot hydraulic control components and systems. 116

PHYSICAL SKILLS
1 - Exhibits appropriate physical response when stimulated by a physical quantity 120

PERSONALITY SKILLS
1 - Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task 130

TROUBLESHOOTING
1 - Troubleshoots and repairs electronic equipment to insure proper operations 139

APPENDICES
Appendix A - Resources 162
Appendix B - Equipment Lists 165
Appendix C - Basic Concepts of Automation 167
Appendix D - Industrial Training Program 168
Appendix E - Academy Participants/Consultants/Task Members 170
Appendix F - Crosswalk 172
Appendix G - Summary of Competencies and Tasks 173

COMPETENCY: Operates keyboard devices.

PERFORMANCE OBJECTIVE 1.a

TASK: Type at 35 wpm.

STANDARD OF PERFORMANCE OF TASK:

Timed typing test scores with 3 or less errors.

SOURCE OF STANDARD: PAQ # 65

CONDITIONS FOR PERFORMANCE OF TASK:

1. Typewriter or keypad.
2. 3 minute straight copy timed writing.

PERFORMANCE GUIDE

COMPETENCY: Operates keyboard devices.

PERFORMANCE OBJECTIVE 1.b

TASK: Perform calculations efficiently and correctly at 25 strokes per minute.

STANDARD OF PERFORMANCE OF TASK: Timed test scores.

SOURCE OF STANDARD: PAQ # 64, 59

CONDITIONS FOR PERFORMANCE OF TASK:

1. Tabulating machine or calculator.
2. 5 minute timed adding test.

PERFORMANCE GUIDE

COMPETENCY: Operates keyboard devices.

PERFORMANCE OBJECTIVE 1.c

TASK: Enter 52 keystrokes per minute.

STANDARD OF PERFORMANCE OF TASK:

100% accuracy with corrections.

SOURCE OF STANDARD: PAQ # 65

CONDITIONS FOR PERFORMANCE OF TASK:

1. Computer terminal.
2. 3 minute timed writing.

PERFORMANCE GUIDE

COMPETENCY: Apply math skills to solve problems.

PERFORMANCE OBJECTIVE 2.a

TASK: Solve general math problems.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: PAQ # 49(3)

CONDITIONS FOR PERFORMANCE OF TASK:

Problems involving: number representation, simple applications, elementary operations and geometric concepts, statistics and probability, and metrics.

PERFORMANCE GUIDE

COMPETENCY: Apply math skills to solve problems.

PERFORMANCE OBJECTIVE 2.b

TASK: Solve algebraic problems.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: PAQ # 49(4)

CONDITIONS FOR PERFORMANCE OF TASK:

Problems involving: linear equations and inequalities, formulas, polynomial factoring and operations, graphing, systems of equations and quadratic equations.

PERFORMANCE GUIDE

COMPETENCY: Apply math skills to solve problems.

PERFORMANCE OBJECTIVE 2.c

TASK: Solve geometry problems.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: PAQ # 49(4)

CONDITIONS FOR PERFORMANCE OF TASK:

Problems involving: Angles, planes, triangles, polygons, circles, constructions, distance in a plane, and transformation.

PERFORMANCE GUIDE

COMPETENCY: Demonstrate written and verbal communication skills.

PERFORMANCE OBJECTIVE 3.a

TASK: Orally present material to an individual or group

STANDARD OF PERFORMANCE OF TASK:

Organized, clear, concise presentation.

CONDITIONS FOR PERFORMANCE OF TASK:

Subject to present to individuals or groups

PERFORMANCE GUIDE

SOURCE OF STANDARD: PAQ # 117, 116, 102, 121, 100, 105, 126

COMPETENCY: Demonstrate written and verbal communication skills.

PERFORMANCE OBJECTIVE 3.b

TASK: Exhibit 10th grade writing skills.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: PAQ # 39

CONDITIONS FOR PERFORMANCE OF TASK:

Standard writing test of grammer, punctuation and spelling.

PERFORMANCE GUIDE

COMPETENCY: Demonstrate reading comprehension skills.

PERFORMANCE OBJECTIVE 4.a

TASK: Exhibit 10th grade reading comprehension skills.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: PAQ # 42, 40

CONDITIONS FOR PERFORMANCE OF TASK:

Standard reading comprehension test.

PERFORMANCE GUIDE

COMPETENCY: Know basic concepts of automated technology.

PERFORMANCE OBJECTIVE 5.a

TASK: Comprehends basic mechanical properties relating to force, motion, energy and torque.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: Writing team

CONDITIONS FOR PERFORMANCE OF TASK:

Mechanical properties test.

PERFORMANCE GUIDE

COMPETENCY: Know basic concepts of automated technology.

PERFORMANCE OBJECTIVE 5.b

TASK: Comprehend basic properties of light: reflection, refraction, dispersion and diffraction.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores

SOURCE OF STANDARD: Writing team

CONDITIONS FOR PERFORMANCE OF TASK:

Light properties test.

PERFORMANCE GUIDE

COMPETENCY: Know basic concepts of automated technology.

PERFORMANCE OBJECTIVE 5.c

TASK: Comprehends temperature, heat and the three forms of heat transfer: conduction, convection and radiation.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: Writing team

CONDITIONS FOR PERFORMANCE OF TASK:

Heat properties test.

PERFORMANCE GUIDE

COMPETENCY: Know basic concepts of automated technology.

PERFORMANCE OBJECTIVE 5.d

TASK: Comprehend gas laws applied to vacuum applications utilizing pumps, components and systems.

STANDARD OF PERFORMANCE OF TASK:

Ninety percent (90%) test scores.

SOURCE OF STANDARD: Writing team

CONDITIONS FOR PERFORMANCE OF TASK:

Vacuum properties test

PERFORMANCE GUIDE

COMPETENCY: Evaluate, analyze, and apply circuit theorems and laws to resistive electrical circuits using general mathematics.

PERFORMANCE OBJECTIVE 1.a

TASK: Determine operating values by applying circuit theorems and laws.

STANDARD OF PERFORMANCE OF TASK:

Values are consistent with calculations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorems
2. Electrical circuits
3. Test equipment

PAQ 48, 40, 37, 31, 6, 4

PERFORMANCE GUIDE:

1. Apply Ohms Law to individual circuit branches.
2. Apply Kirchoff's Laws.
3. Apply other circuit theorems.
4. Calculate circuit parameters.

COMPETENCY: Evaluate, analyze, and apply circuit theorems and laws to resistive electrical circuits using general mathematics.

PERFORMANCE OBJECTIVE 1.b

TASK: Simplify circuits by using Thevenin's theorem.

STANDARD OF PERFORMANCE OF TASK:

Forecast of maximum voltage transferred between two circuits. Compare calculations for consistency with laboratory measurements.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorem
2. Electrical circuit
3. Test equipment

PAQ 48, 40, 37

PERFORMANCE GUIDE:

1. Simplify circuit using Thevenin's Theorem.
2. Calculate parameters.

COMPETENCY: Evaluate, analyze, and apply circuit theorems and laws to resistive electrical circuits using general mathematics.

PERFORMANCE OBJECTIVE 1.c

TASK: Simplify circuits by using Norton's theorem.

STANDARD OF PERFORMANCE OF TASK:

Operating values are consistent with calculations.

PERFORMANCE GUIDE:

1. Simplify circuit using Norton's Theorem.
2. Calculate circuit parameters.

COMPETENCY: Evaluate, analyze, and apply circuit theorems and laws to resistive electrical circuits using general mathematics.

PERFORMANCE OBJECTIVE 1.d

TASK: Analyze circuits that have more than one voltage or current source using superposition theorem.

STANDARD OF PERFORMANCE OF TASK:

Operating values are consistent with calculations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Electrical circuits
2. Test equipment
3. Circuit theorems

PAQ 48, 40, 37

PERFORMANCE GUIDE:

1. Calculate circuit values where more than one voltage source exists in a circuit.

2. Calculate circuit values where more than one current source exists in the circuit.

COMPETENCY: Evaluate and analyze electric circuits using right triangle trigonometry.

PERFORMANCE OBJECTIVE 2.a

TASK: Calculate impedance of series and parallel AC circuits.

STANDARD OF PERFORMANCE OF TASK:

Operating values are consistent with calculations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorems and laws
2. Electrical circuits
3. Test equipment

PAQ 48, 40, 37

PERFORMANCE GUIDE:

1. Series circuit impedance
2. Parallel circuit impedance

COMPETENCY: Evaluate and analyze electric circuits using right triangle trigonometry.

PERFORMANCE OBJECTIVE 2.b

TASK: Evaluate complex electric circuits to determine operating values.

STANDARD OF PERFORMANCE OF TASK:

Operating values are consistent with calculations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorems and laws
2. Electrical circuits
3. Test equipment

PAQ 48, 40, 37

PERFORMANCE GUIDE:

1. Resonant frequency
2. Circuit impedance
3. Voltage and current relationships
4. Resistive and reactive circuit components

COMPETENCY: Evaluate and analyze electric circuits using phasor algebra.

PERFORMANCE OBJECTIVE 3.a

TASK: Calculate phase shift of AC circuit parameters.

STANDARD OF PERFORMANCE OF TASK:

Measure phase shift to verify calculations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit laws and theorems
2. Electrical circuit
3. Test equipment
4. Phasor algebra

PAQ 48, 37, 40

PERFORMANCE GUIDE:

1. Series circuits
2. Parallel circuits
3. Combination circuits

COMPETENCY: Evaluate and analyze electric circuits using phasor algebra.

PERFORMANCE OBJECTIVE 3.b

TASK: Calculate amplitude levels of AC voltage and currents.

STANDARD OF PERFORMANCE OF TASK:

Amplitude levels of operating parameters are consistent with calculated values.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit laws and theorems
2. Electrical circuit
3. Test equipment
4. Phasor algebra

PAQ 48, 37, 40

PERFORMANCE GUIDE:

1. Series circuits
2. Parallel circuits
3. Combination circuits

COMPETENCY: Measure circuit gain, frequency response and determine power dissipation of active circuits or subsystems.

PERFORMANCE OBJECTIVE 4.a

TASK: Measure gain of an amplifier circuit using numeric ratio and decibels.

STANDARD OF PERFORMANCE OF TASK:

Measured gain is within a specified manufacturing tolerance.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit laws and theorems
2. Electrical circuit
3. Test equipment
4. DB meter

PAQ 48, 37, 6, 25, 24, 78

PERFORMANCE GUIDE:

1. Measure output value in DB.
2. Measure input value in DB.
3. Subtract input value from output value.
4. Record value of calculated gain in DB.

COMPETENCY: Measure circuit gain, frequency response and determine power dissipation of active circuits or subsystems.

PERFORMANCE OBJECTIVE 4.b

TASK: Measure circuit or system frequency response.

STANDARD OF PERFORMANCE OF TASK:

Measured frequency response is reproducible to a specified manufacturing tolerance.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorems and laws
2. Electrical circuit
3. Test equipment
4. Frequency meter
5. Level indicating meter

PAQ 48, 31, 6, 4

PERFORMANCE GUIDE:

1. Keep input voltage constant.
2. Vary input frequency.
3. Divide output by input to obtain gain.
4. Plot gain vs. frequency to obtain frequency response.
5. Convert voltage gain to DB and DB to voltage ratio.

COMPETENCY: Measure circuit gain, frequency response and determine power dissipation of active circuits or subsystems.

PERFORMANCE OBJECTIVE 4.c

TASK: Observe and note changes in waveforms.

STANDARD OF PERFORMANCE OF TASK:

Compare the waveforms as displayed by oscilloscope to manufacturer's specified waveform(s).

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit theorems and laws
2. Electrical circuit
3. Test equipment
4. Oscilloscope

PAQ 48, 40, 37, 31

PERFORMANCE GUIDE:

1. Sketch waveform.
2. Measure peak-to-peak values of the amplitude.
3. Measure time period or frequency.
4. Note any changes that occur in relationship to time.

COMPETENCY: Write technical reports documenting corrective action procedures.

PERFORMANCE OBJECTIVE 5.a

TASK: Collect and record data.

STANDARD OF PERFORMANCE OF TASK:

Accurate and complete data.

CONDITIONS FOR PERFORMANCE OF TASK:

Test and environmental data

PAQ 48, 37

PERFORMANCE GUIDE:

1. Tabulate data.
2. Classify or group data.
3. Statistically analyze data.
4. Report results.

COMPETENCY: Write technical reports documenting corrective action procedures.

PERFORMANCE OBJECTIVE 5.b

TASK: Write corrective action reports.

STANDARD OF PERFORMANCE OF TASK:

Corrective action report reflects needed changes identified from the test and enviromental data.

CONDITIONS FOR PERFORMANCE OF TASK:

Test and environmental data

PAQ 48, 37

PERFORMANCE GUIDE:

COMPETENCY: Sketch schematics and pictorials of circuit layouts and test setups.

PERFORMANCE OBJECTIVE 6.a

TASK: Sketch circuit schematics.

STANDARD OF PERFORMANCE OF TASK:

Meet standard industrial and company sketching specifications.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Parts list
2. Wire list
3. Parts layout
4. Rough circuit sketches

PAQ 48, 37

PERFORMANCE GUIDE:

1. Draw circuit diagrams.
2. Label parts on drawings.

COMPETENCY: Sketch schematics and pictorials of circuit layouts and test setups.

PERFORMANCE OBJECTIVE 6.b

TASK:

Sketch pictorial layouts of:
1. Components and placement
2. Test set ups
3. Assembly modifications

STANDARD OF PERFORMANCE OF TASK:

Meet standard industrial and company sketching specifications.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Technical information
2. Spatial knowledge of the problem
3. Sketching supplies

PAQ 3, 6, 40, 48, 56, 58

PERFORMANCE GUIDE:

1. Sketch components.
2. Sketch parts placement.
3. Sketch test setups.
4. Sketch changes on assembly drawings.

COMPETENCY: Construct circuits, sub-assemblies and systems from schematics, pictorials, wire and component lists.

PERFORMANCE OBJECTIVE 7.a

TASK: Check component lists against schematics.

STANDARD OF PERFORMANCE OF TASK:

Components listed correspond with the components shown on the schematic with 100% accuracy.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Component list
2. Schematic
3. Wire list
4. Pictorial

PAQ 3, 37, 39, 40, 42, 46, 48

PERFORMANCE GUIDE:

COMPETENCY: Construct circuits, sub-assemblies and systems from schematics, pictorials, wire and component lists.

PERFORMANCE OBJECTIVE 7.b

TASK: Interpret wire lists.

STANDARD OF PERFORMANCE OF TASK:

Wire list corresponds to electrical schematic.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Wire list
2. Chassis or circuit board.

PAQ 3, 6, 23, 31, 39, 40, 49, 58

PERFORMANCE GUIDE:

COMPETENCY: Construct circuits, sub-assemblies and systems from schematics, pictorials, wire and component lists.

PERFORMANCE OBJECTIVE 7.c

TASK: Assemble products using schematics and pictorial diagrams.

STANDARD OF PERFORMANCE OF TASK:

Correctly place components, wire and harness and make electrical connections as specified on the product.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Schematics and pictorial drawings.
2. Components and wire.
3. Sub-assemblies

PAQ 3, 23, 37, 39, 40, 42, 48, 50, 54, 55, 58, 61, 81

PERFORMANCE GUIDE:

1. Verify pictorial using schematic.
2. Locate parts.
3. Assemble product using pictorial drawing.

COMPETENCY: Audit product performance by using production change orders and test specification sheets.

PERFORMANCE OBJECTIVE 8.a

TASK: Verify product performance.

STANDARD OF PERFORMANCE OF TASK:

Measure electrical quantities and compare with correct values at the points designated by the production change orders and specifications sheets.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Test equipment
2. Specification sheets
3. Change orders

PAQ 5, 6, 39, 40, 42, 46, 54, 78, 95, 172, 48

PERFORMANCE GUIDE:

1. Measure voltage at test points.
2. Measure current at test points.
3. Measure impedance at test points.
4. Measure power at test points.

COMPETENCY: Classify component quality by measuring their physical and electrical properties.

PERFORMANCE OBJECTIVE 9.a

TASK: Visually inspect components.

STANDARD OF PERFORMANCE OF TASK:

Visually separate abnormal from normal components.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Component batch
2. Eye Lupe

PAQ 9, 20, 21, 48, 80, 23, 31, 32

PERFORMANCE GUIDE:

1. Check physical characteristics.
2. Separate by physical quality.

COMPETENCY: Classify component quality by measuring their physical and electrical properties.

PERFORMANCE OBJECTIVE 9.b

TASK: Verify physical size.

STANDARD OF PERFORMANCE OF TASK:

Classify like components by size characteristics as compared to manufacturer's specifications.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Chart showing part sizes
2. Components
3. Hand mechanical measuring instruments
4. Automated measuring instrumentation

PAQ 9, 20, 21, 32, 48

PERFORMANCE GUIDE:

1. Measure components with a micrometer.
2. Measure components with a caliper.
3. Use depth gauge to measure depression sizes.
4. Use automated test instruments to measure sizes.

COMPETENCY: Classify component quality by measuring their physical and electrical properties.

PERFORMANCE OBJECTIVE 9.c

TASK: Test electrical properties.

STANDARD OF PERFORMANCE OF TASK:

Comparison of measured electrical parameters to manufacturer's stated value and tolerance.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Test equipment
2. Components

PAQ 5, 31, 40, 42, 59, 78, 48

PERFORMANCE GUIDE:

COMPETENCY: Classify component quality by measuring their physical and electrical properties.

PERFORMANCE OBJECTIVE 9.d

TASK: Sort and categorize components by environmental, physical, and electrical tolerances.

STANDARD OF PERFORMANCE OF TASK:

Comparison of measured to manufacturer's stated values and tolerances.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Components
2. Electronic and mechanical measuring instruments
3. Manufacturer's specification sheets

PAQ 6, 20, 21, 34, 40, 42, 46, 48, 58, 59

PERFORMANCE GUIDE:

1. Separate components by environmental factors.
2. Use physical tolerances to sort components.
3. Separate components by electrical tolerances.

COMPETENCY: Identify active circuit configurations.

PERFORMANCE OBJECTIVE 10.a

TASK: Recognize basic circuit types.

STANDARD OF PERFORMANCE OF TASK:

Identify individual circuits on schematics by function and components.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Active circuit configurations in schematic form
2. Amplifier
3. Oscillators
4. IF circuits
5. RF circuits
6. Digital circuits
7. Power supplies

PAQ 3, 42, 46, 48

PERFORMANCE GUIDE:

1. Memorization of key circuit configurations.

COMPETENCY: Analyze devices using manufacturers' data sheets.

PERFORMANCE OBJECTIVE 11.a

TASK: Determine device characteristics.

STANDARD OF PERFORMANCE OF TASK:

Use electrical data of devices to confirm operating characteristics.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Manufacturer's data sheets
2. Devices
3. Test equipment

PAQ 3, 31, 40, 48

PERFORMANCE GUIDE:

COMPETENCY: Analyze devices using manufacturers' data sheets.

PERFORMANCE OBJECTIVE 11.b

TASK: Bias active devices for typical operation.

STANDARD OF PERFORMANCE OF TASK:

Compare measured to calculated values or estimations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Data sheets
2. Devices
3. Test equipment

PAQ 39, 40, 48

PERFORMANCE GUIDE:

1. Use biasing techniques on devices.
2. Inject appropriate signal.

COMPETENCY: Use power sources and grounding techniques to ensure proper system performance.

PERFORMANCE OBJECTIVE 12.a

TASK: Test and evaluate power supplies.

STANDARD OF PERFORMANCE OF TASK:

Voltage source exhibits minimum fluxuation, is freer from meaningful extraneous parasitic signals, and meets rated output voltage.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Test equipment
2. Schematics
3. Electronic system
4. Selected documentation

PAQ 6, 40, 48, 55, 78, 81

PERFORMANCE GUIDE:

1. Check line regulation.
2. Check load regulation.
3. Measure output ripple.
4. Measure output voltage.
5. Verify power supply is not oscillating.

COMPETENCY: Use power sources and grounding techniques to ensure proper system performance.

PERFORMANCE OBJECTIVE 12.b

TASK: Determine the difference between chassis and neutral ground.

STANDARD OF PERFORMANCE OF TASK:

Measure and compare voltages from chassis ground and neutral ground and note differences in systems.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Test equipment
2. System with chassis and neutral ground
3. Chassis and neutral ground examination
4. Selected documentation

PAQ 3, 6, 5, 37, 39, 40, 42, 46, 48

PERFORMANCE GUIDE:

COMPETENCY: Use power sources and grounding techniques to ensure proper system performance.

PERFORMANCE OBJECTIVE 12.c

TASK: Monitor power sources electronically.

STANDARD OF PERFORMANCE OF TASK:

Measure power output voltage, current, and ripple as identified in manufacturer's operating and service manuals.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Test equipment
2. Power sources: low voltage, AC and DC
3. Underwriter's Laboratory specifications and application notes

PAQ 5, 6, 31, 40, 48

PERFORMANCE GUIDE:

1. Connect monitors.
2. Read meters.
3. Log results.

COMPETENCY: Use power sources and grounding techniques to ensure proper system performance.

PERFORMANCE OBJECTIVE 12.d

TASK: Ground circuit, sub-assembly, and systems.

STANDARD OF PERFORMANCE OF TASK:

Grounding techniques must comply with standards set by manufacturer's and underwriters laboratories.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Circuit, sub-assemblies, system
2. Schematic
3. Test instrument
4. Selected documentation:
   a. grounding
   b. wire size
   c. runner size
   d. materials
   e. continuity testing
5. Underwriter's Laboratories specifications

PAQ 3, 5, 6, 31, 40, 42, 46, 48

PERFORMANCE GUIDE:

COMPETENCY: Analyze combinatorial logic circuits.

PERFORMANCE OBJECTIVE 1.a

TASK: Identify logic gates.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct identification of all gates.

SOURCE OF STANDARD: PAQ #3, 42

CONDITIONS FOR PERFORMANCE OF TASK:

Combinatorial logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify gates to include: AND, NAND, OR, NOR, XOR, XNOR.

COMPETENCY: Analyze combinatorial logic circuits.

PERFORMANCE OBJECTIVE 1.b

TASK: Trace logic levels.

STANDARD OF PERFORMANCE OF TASK:

Traced signals conform to manufacturer's specifications.

SOURCE OF STANDARD: PAQ #3, 20(4)

CONDITIONS FOR PERFORMANCE OF TASK:

Combinatorial logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify logic (positive or negative).
2) Trace on paper the logic levels at any specified area of the schematic or diagram.

COMPETENCY: Analyze combinatorial logic circuits.

PERFORMANCE OBJECTIVE 1.c

TASK: Interpret truth tables.

STANDARD OF PERFORMANCE OF TASK:

Correctly draw circuits that verify truth table.

SOURCE OF STANDARD: PAQ #3, 42

CONDITIONS FOR PERFORMANCE OF TASK:

Combinatorial logic circuit truth table.

PERFORMANCE GUIDE:

1) Know binary numbering system.
2) Use either sum or products, DeMorgan's theorem or Karnaugh map for simplification.
3) Draw logic diagram for specified truth table.

COMPETENCY: Analyze combinatorial logic circuits.

PERFORMANCE OBJECTIVE 1.d

TASK: Interpret ladder diagram.

STANDARD OF PERFORMANCE OF TASK:

Ability to predict final logic state.

SOURCE OF STANDARD: PAQ #3, 42

CONDITIONS FOR PERFORMANCE OF TASK:

1) Combinatorial logic ladder diagram.

PERFORMANCE GUIDE:

1) Know ladder diagram symbols.
2) Know relay-type instruction.
3) Know timer and counter instructions.
4) Know arithmetic operations.
5) Identify: Data manipulation and transfer operations/program control operations.
6) Determine outcome or result of process.

COMPETENCY: Analyze sequential logic circuits.

PERFORMANCE OBJECTIVE 2.a

TASK: Identify Flip-Flops

STANDARD OF PERFORMANCE OF TASK:

By type and circuit configuration.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify Flip-Flops to include:
Set/reset, master/slave, steerable, D-catch, D and J-K.

COMPETENCY: Analyze sequential logic circuits.

PERFORMANCE OBJECTIVE 2.b

TASK: Identify simple and complex counters.

STANDARD OF PERFORMANCE OF TASK:

By type and configuration.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify simple counters to include: Shift registers, ripple and synchronous counters.
2) Identify complex counters to include: Shift counters (Ring and Johnson), trucated and missing state.

COMPETENCY: Analyze sequential logic circuits.

PERFORMANCE OBJECTIVE 2.c

TASK: Identify clock circuit characteristics.

STANDARD OF PERFORMANCE OF TASK:

By type and circuit configuration.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify clock circuits to include: Clock frequency or timed period and phase.

COMPETENCY: Analyze sequential logic circuits.

PERFORMANCE OBJECTIVE 2.d

TASK: Trace logic levels.

STANDARD OF PERFORMANCE OF TASK:

Tracing signals conform to manufacturer's specifications.

SOURCE OF STANDARD: PAQ #3, 20(4)

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit or diagrams.

PERFORMANCE GUIDE:

1) Identify logic (positive or negative).
2) Trace on paper the logic levels at any specified area of schematic or diagram.

COMPETENCY: Analyze sequential logic circuits.

PERFORMANCE OBJECTIVE 2.e

TASK: Interpret timing and control.

STANDARD OF PERFORMANCE OF TASK:

Correctly predicted output voltage waveform that would result from any given set of input voltage waveforms.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify logic (positive or negative).
2) Given any timing state predict the output at that specific state.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.a

TASK: Identify the microprocessor.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct identification.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify the manufacturers number for the microprocessor.
2) Identify the bit-technology of the microprocessor (8, 16, or 32).
3) Identify power and clock requirements.
4) Identify pin configuration.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.b

TASK: Discriminate between digital logic circuit and microprocessor circuit.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct discrimination.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify combinatorial and sequential circuits.
2) Identify central processing unit, memory circuits and input/output configurations.
3) Discriminate between the digital circuitry and the computer circuit.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.c

TASK: Identify the support chips.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct identification.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.
Manufacturer's databooks: I. C. Master.

PERFORMANCE GUIDE:

1) Identify the manufacturer's number.
2) Locate the appropriate databook and identify: a) Type of chip, b) bit technology, c) power and clock requirements, d) input/output configuration, and e) pin configuration.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.d

TASK: Identify bus structure and I/O.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct identification.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify address bus.
2) Identify data bus.
3) Identify control bus.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.e

TASK: Interpret related timing and control diagrams.

STANDARD OF PERFORMANCE OF TASK:

Discrimination between fetch and execute cycles.

SOURCE OF STANDARD: PAQ #3, 42

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.

PERFORMANCE GUIDE:

1) Identify machine cycle.
2) Identify op-codes.
3) Identify fetch cycle.
4) Identify execute cycle.
5) Discriminate between fetch and execute.

COMPETENCY: Analyze microprocessor-based logic circuits.

PERFORMANCE OBJECTIVE 3.f

TASK: Trace logic levels.

STANDARD OF PERFORMANCE OF TASK:

Traced signals conform to manufacturer's specifications.

SOURCE OF STANDARD: PAQ #3, 20(4)

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit or diagram.

PERFORMANCE GUIDE:

1. Identify logic (negative or positive).
2. Trace on paper the logic levels at any specified area of the schematic or diagram.

COMPETENCY: Analyze peripheral devices.

PERFORMANCE OBJECTIVE 4.a

TASK: Identify peripheral chips.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct identification.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Peripheral device.

PERFORMANCE GUIDE:

1. Identify peripheral chips to include: peripheral interface adapters, parallel input/output controllers, programmable interupt controller, direct memory access controller and universal asynchronas receiver/transmitter chips.

COMPETENCY: Analyze peripheral devices.

PERFORMANCE OBJECTIVE 4.b

TASK: Apply interfacing processes.

STANDARD OF PERFORMANCE OF TASK:

Peripheral devices operate per manufacturer's specifications.

SOURCE OF STANDARD: PAQ #3

CONDITIONS FOR PERFORMANCE OF TASK:

Peripheral device.

PERFORMANCE GUIDE:

1. Identify interfacing process to include: serial or parallel, memory-mapped, programmed or interupt-driven input/output.

COMPETENCY: Test and measure digital logic circuits.

PERFORMANCE OBJECTIVE 5.a

TASK: Test and measure combinatorial logic circuits.

STANDARD OF PERFORMANCE OF TASK:

Proper output for any given input.

SOURCE OF STANDARD: PAQ #3, 20(4), 54, 66

CONDITIONS FOR PERFORMANCE OF TASK:

Combinatorial logic circuit.
Logic probe.
Logic pulser.

PERFORMANCE GUIDE:

1. Inject logic levels with pulser if necessary.
2. Observe output with logic probe.
3. Determine if circuit is functioning correctly.

COMPETENCY: Test and measure digital logic circuits.

PERFORMANCE OBJECTIVE 5.b

TASK: Test and measure sequential logic circuits.

STANDARD OF PERFORMANCE OF TASK:

Measurements follow state transition diagram.

SOURCE OF STANDARD: PAQ #3, 20(4), 54, 66

CONDITIONS FOR PERFORMANCE OF TASK:

Sequential logic circuit.
Logic probe.
Logic pulser.
Logic monitor.
State transition diagram.

PERFORMANCE GUIDE:

1. Use logic pulser to inject pulses or logic levels if necessary.
2. Use the logic probe or monitor to observe output.
3. Using state transition diagram and measurements, determine if circuit is functioning correctly.

COMPETENCY: Test and measure digital logic circuits.

PERFORMANCE OBJECTIVE 5.c

TASK: Test and measure microprocessor-based logic circuits.

STANDARD OF PERFORMANCE OF TASK:

One hundred percent (100%) correct truth table obtained.

SOURCE OF STANDARD: PAQ #3, 20(4), 54, 66

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor-based logic circuit.
Logic analyzer, logic probe, pulser and monitor.
High-speed scope.
Truth table/timing diagram.

PERFORMANCE GUIDE:

1. Use logic pulser to inject pulse trains or logic levels if necessary.
2. Use the logic probe, monitor analyzer and/or high-speed scope to observe circuit operation.
3. Using the truth table/timing diagram and the measurements obtained, determine if the circuit is functioning correctly.

COMPETENCY: Program a dedicated microprocessor.

PERFORMANCE OBJECTIVE 6.a

TASK: Program a microprocessor using binary, hexadecimal and octal numbers.

STANDARD OF PERFORMANCE OF TASK:

A program will run and execute or a given mircroprocessor such that the operator understands the working of the particular microprocessor through its programming model and by comparing expected to actual output.

SOURCE OF STANDARD: Writing team

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor
Instruction set
Input, output specifications

PERFORMANCE GUIDE:

1. Use instruction set.
2. Use the microprocessor program model.
3. Write, enter and test programs.
    a. Arithmetic operations
    b. Branching
    c. Looping
    d. Timing
    e. Memory clear and move

COMPETENCY: Program a dedicated microprocessor.

PERFORMANCE OBJECTIVE 6.b

TASK: Recognize the difference between the addressing structures in a particular microprocessor.

STANDARD OF PERFORMANCE OF TASK:

Utilize and translate data in the central processing unit, memory and input/output system using the various addressing structures of a particular microprocessor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor
Instruction set
Input, output specifications

PERFORMANCE GUIDE:

1. Use instruction set.
2. Use the microprocessor program model.
3. Write, enter and test programs.
   a. Arithmetic operations
   b. Branching
   c. Looping
   d. Timing
   e. Memorey clear and move

COMPETENCY: Program a dedicated microprocessor.

PERFORMANCE OBJECTIVE 6.c

TASK: Write a program, for a specific microprocessor.

STANDARD OF PERFORMANCE OF TASK:

Expected output matches actual result.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Microprocessor
Instruction set
Input, output specifications

PERFORMANCE GUIDE:

1. Use instruction set.
2. Use the microprocessor program model.
3. Write, enter and test programs.
   a. Arithmetic operations
   b. Branching
   c. Looping
   d. Timing
   e. Memory clear and move

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.a

TASK: Practice respiratory protection.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. A specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.b

TASK: Practices eye protection methods.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. A specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.c

TASK: Practices ear protection.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. A specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.d

TASK: Practices nose protection.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. A specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.e

TASK: Practices skin protection methods.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.f

TASK: Practices foot protection methods.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Specific industrial environment.
2. Appropriate safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.g

TASK: Distinguish long and short term toxicity affects.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Familiarization with symptoms of body irregularity.
2. Familiarization with relevant medical tests and/or body sensing devices
3. Familiarization with basic chemicals.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.h

TASK: Reduces air contamination.

STANDARD OF PERFORMANCE OF TASK:

No change from normal air-quality reading.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Handling techniques of toxic substances.
2. Job task.
3. Air-quality instrumentation.
4. Proper ventilation procedures.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.i

TASK: Reduces chemical hazard.

STANDARD OF PERFORMANCE OF TASK:

Neglible change from physical norms.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Proper storage and handling techniques of chemicals.
2. Job task.

PERFORMANCE GUIDE:

1. Know chemical hygiene.
2. Exhibit awareness of chemical environment.
3. Apply proper storage and handling techniques.

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.j

TASK: Reduces personal contamination and injury.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Safe use of clothing and accessories.
2. Job task.
3. Safety accessories and special garments.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.k

TASK: Avoid electrical shock.

STANDARD OF PERFORMANCE OF TASK:

Negligible change from a physical norm.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Knowledge of dangerous electric current ranges.
2. Electrical safety procedures.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.1

TASK: Works with one hand and one hand only while working on energized electrical equipment.

STANDARD OF PERFORMANCE OF TASK:

Observed safety precautions exhibited by the worker

CONDITIONS FOR PERFORMANCE OF TASK:

1. Job task involving energized equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.m

TASK: Avoid overloading circuits.

STANDARD OF PERFORMANCE OF TASK:

Safely functioning circuit.

CONDITIONS FOR PERFORMANCE OF TASK:

Electrical feed safety code.
Electrical circuit

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.n

TASK: Remove jewelry.

STANDARD OF PERFORMANCE OF TASK:

Absence of jewelry on worker.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Job task involving energized equipment

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.0

TASK: Identify hazard warning signs.

STANDARD OF PERFORMANCE OF TASK:

Observed worker reaction to sign.

CONDITIONS FOR PERFORMANCE OF TASK:

1. A specific industrial environment.
2. Safety handbooks.
3. Model floor plan.
4. Hazard warning signs.

PERFORMANCE GUIDE:

1. Locate handbooks describing warning signs.
2. Analyze and diagram specific industrial setting established locations for appropriate signs.
3. Appraise and evaluate signs in peer group setting.

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.p

TASK: Practice fire safety.

STANDARD OF PERFORMANCE OF TASK:

Work site free of fire hazards.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Fire related hazards and prevention.
2. Fire extinguishing devices.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.q

TASK: Operate hand tools safely.

STANDARD OF PERFORMANCE OF TASK:

Tools used for intended purposes only.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Hand tools common to Electronics and Semiconductor fabrication industries.
2. Manufacturer's operating and use manuals.

PERFORMANCE GUIDE:

1. Obtain manufacturer's operating, use and service manual.
2. Clean tools.
3. Access tool condition.
4. Determine procedure for proper use.
5. Determine procedure for maintenance.
6. Determine procedure for repair.
7. Carry out necessary sequence.

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.r

TASK: Operate power tools safely.

STANDARD OF PERFORMANCE OF TASK:

Tools used for intended purposes.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Power tools (i.e., saws, drills, pneumatic tools).
2. Manufacturer's operation and service procedures.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.s

TASK: Avoids bypassing safety devices.

STANDARD OF PERFORMANCE OF TASK:

Correctly working safety devices.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Tasks involving interlocks.
2. Tasks involving working with fuses and safety devices.
3. Energized equipment.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.t

TASK: Practices standard grounding techniques at all power feed points to reduce shock hazards.

STANDARD OF PERFORMANCE OF TASK:

Electrical grounding techniques with no electrical code violations.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Grounding principles.
2. Basic electrical code.

PERFORMANCE GUIDE:

COMPETENCY: Observes and follows personal and plant safety requirements.

PERFORMANCE OBJECTIVE 1.u

TASK: Insures that all power feed switches are in the off position.

STANDARD OF PERFORMANCE OF TASK:

De-energized equipment.

CONDITIONS FOR PERFORMANCE OF TASK:

1. Power feed switch location and position.
2. Task requiring maintenance or repair of energized equipment.

PERFORMANCE GUIDE:

REFERENCES

Green/Turk. Safety in Workign With Chemicals, Macmillan, 1978.

Handbook of Reactive Safetys.

Handbook of Laboratory Safety.

National Academy Press. Prudent Practices for Handling Safetyous Chemicals Laboratories, 1981.

Royal Society of Chemists. Hazards in the Chemical Lab, edited by Bretherice, 3rd edition, 1981.

Six Dangerous Properties of Industrial Materials.

COMPETENCY: Follows personal hygiene practices for working in industry.

PERFORMANCE OBJECTIVE 1.a

TASK: Know personal body functions and related cleanliness.

STANDARD OF PERFORMANCE OF TASK:

A 90% percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

Written test on body functions.

PERFORMANCE GUIDE:

COMPETENCY: Follows personal hygiene practices for working in industry.

PERFORMANCE OBJECTIVE 1.b

TASK: Follows personal hygiene practices regarding body hair.

STANDARD OF PERFORMANCE OF TASK:

Normal operation is not interrupted

CONDITIONS FOR PERFORMANCE OF TASK:

PERFORMANCE GUIDE:

COMPETENCY: Follows personal hygiene practices for working in industry.

PERFORMANCE OBJECTIVE 1.c

TASK: Wears appropriate clothing.

STANDARD OF PERFORMANCE OF TASK:

Normal operation is not interrupted.

CONDITIONS FOR PERFORMANCE OF TASK:

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.a

TASK: Knows general plant hygiene requirements by area: office, factory, shipping, field environments.

STANDARD OF PERFORMANCE OF TASK:

90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written general hygiene test.

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.b

TASK: Knows hygiene related handling of chemicals.

STANDARD OF PERFORMANCE OF TASK:

A 90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written chemical hygiene test.

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.c

TASK: Knows waste disposal techniques.

STANDARD OF PERFORMANCE OF TASK:

A 90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written waste disposal test.

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.d

TASK: Knows office hygiene procedures.

STANDARD OF PERFORMANCE OF TASK:

A 90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written office hygiene test.

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.e

TASK: Knows factory hygiene methods (Warehouse, general factory, semi-clean room, clean room).

STANDARD OF PERFORMANCE OF TASK:

A 90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written factory hygiene test.

PERFORMANCE GUIDE:

COMPETENCY: Knows hygiene requirements of the working environments in the Electronics Industry.

PERFORMANCE OBJECTIVE 2.f

TASK: Knows packaging hygiene for manufacturing processes.

STANDARD OF PERFORMANCE OF TASK:

A 90 percent score.

CONDITIONS FOR PERFORMANCE OF TASK:

A written packaging hygiene test.

PERFORMANCE GUIDE:

COMPETENCY: Uses Physical Optics to perform alignment of electromechanical - optical systems.

PERFORMANCE OBJECTIVE 1.a

TASK: Operate and maintain optical testing and measuring instruments:

A. OAI Light Monitor
B. Eye Lupes
C. Light Intensity Meter
D. Optical Cleaning Materials

STANDARD OF PERFORMANCE OF TASK:

1. Successfuly operate equipment in presence of supervisor.
2. Successful completion of test at 90th percentile.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. OAI Light monitor
2. Eye lupes
3. Light intensity meter
4. Optical cleaning materials
5. Equipment operating and maintenance manuals
6. Laboratory report format
7. Test

PERFORMANCE GUIDE:

COMPETENCY: Use geometric optics to perform servicing and alignment procedures on automated test equipment.

PERFORMANCE OBJECTIVE 2.a

TASK: Comprehend and apply the properties of lenses in the use of optical equipment.

STANDARD OF PERFORMANCE OF TASK:

1. Successful completion of test at 90th percentile.
2. Successful summary of laboratory activities as demonstrated by written laboratory report acceptable to supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Lens -- laboratory experiment set.
2. Lens characteristics.
3. Test.
4. Laboratory report format.

PERFORMANCE GUIDE:

COMPETENCY: Use geometric optics to perform servicing and alignment procedures on automated test equipment.

PERFORMANCE OBJECTIVE 2.b

TASK: Operate a Bell stereo microscope for observation of semiconductor substrate physical characteristics.

STANDARD OF PERFORMANCE OF TASK:

Sketches a known substrate with total accuracy.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Bell stereo microscope.
2. Samples
3. Manufacturer's operating procedures.
4. Laboratory report format.

PERFORMANCE GUIDE:

1. Adjust for clearest vision.
2. Properly illuminate object.
3. Adjust for depth of field.
4. Observe isolation areas.
5. Observe base regions.
6. Observe emitter regions.
7. Observe collector regions.
8. Observe and sketch single layer deposition on substrate.

COMPETENCY: Use geometric optics to perform servicing and alignment procedures on automated test equipment using optics.

PERFORMANCE OBJECTIVE 2.c

TASK: Perform manufacturers' specified maintenance on optical equipment in automated manufacturing systems.

STANDARD OF PERFORMANCE OF TASK:

Equipment will operate within designated company specifications as evidenced by supervisor verification of operation. A laboratory report will summarize problem and solution sequence and results of repair process.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Equipment with optical features.
2. Specific operating and alignment procedures.
3. Applicable test equipment.
4. Equipment with an optical problem.
5. Laboratory report format.

PERFORMANCE GUIDE:

COMPETENCY: Use laser to perform selected industrial manufacturing processes.

PERFORMANCE OBJECTIVE 3.a

TASK: Follow safety guidelines when working with lasers.

STANDARD OF PERFORMANCE OF TASK:

The worker will pass an eye/laser safety examination as required by the employer.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Dangerous levels of light illumination.
2. Safety glasses and goggles.

PERFORMANCE GUIDE:

COMPETENCY: Use laser to perform selected industrial manufacturing processes.

PERFORMANCE OBJECTIVE 3.b

TASK: Measure distances and angles using lasers.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of written or oral and/or practical test as evidenced by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Laser system.
2. Measurement devices and apparatus.

PERFORMANCE GUIDE:

COMPETENCY: Use laser to perform selected industrial manufacturing processes.

PERFORMANCE OBJECTIVE 3.c

TASK: Cut, drill and weld with lasers.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of practical test as evidenced by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Laser cutter, driller or welder.
2. Manufacturer's operating and maintenance manual.
3. Material to weld, cut or drill.
4. Related safety equipment.

PERFORMANCE GUIDE:

COMPETENCY: Use laser to perform selected industrial manufacturing processes.

PERFORMANCE OBJECTIVE 3.d

TASK: Evaluate, troubleshoot and repair a basic laser system.

STANDARD OF PERFORMANCE OF TASK:

The worker will repair a basic laser system such that it's operation will not deviate from the manufacturer's specifications as allowed by local industrial standards.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Manufacturer's operation and maintenance manual.
2. Basic tool kit.
3. Replacement parts.
4. Safety eye wear.

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoot fiber optic control systems.

PERFORMANCE OBJECTIVE 4.a

TASK: Identify faulty components and measure parameters used in fiber optics communication systems.

STANDARD OF PERFORMANCE OF TASK:

Satsifactory completion of practical test.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Basic fiber optic control system.
2. Manufacturer's operation and maintenance manual.
3. Selected components and specifications.
4. Test.

PERFORMANCE GUIDE:

1. Examine optical fibers, sources and receivers.
2. Study device specifications.
3. Know assembly techniques.
4. Measure signal flow.
5. Transmit and receive a standard set of data or information.
6. Trouble shoot system if necessary.
7. Practice good assembly and maintenance practices.

COMPETENCY: Troubleshoot fiber optic control systems.

PERFORMANCE OBJECTIVE 4.b

TASK: Troubleshoot and repair minor problems in short link fiber optic communication systems: Simplex, Half Duplex and Full Duplex.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of written or oral and or practical test as evidenced by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Basic fiber optics control system.
2. Manufacturer's operation and maintenance manual.
3. Selected components and specifications.
4. Test.

PERFORMANCE GUIDE:

1. Build, trouble shoot and test a short link simplex communication system.
2. Build, trouble shoot and test a short link half-duplex communication system.
3. Build, trouble shoot and test a short link full-duplex communication system.

COMPETENCY: Assemble, test and troubleshoot programmable controllers, and associated input output devices.

PERFORMANCE OBJECTIVE 1.a

TASK: Use basic numbering systems, codes and logic concepts of programmable controllers.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of a written test to meet company requirements.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Programmable controller.
2. Input sensing capability.
3. Output control capability
4. Peripherial devices.

PERFORMANCE GUIDE:

1. Know numbering systems Base 16, 8, 10, 2
2. Know number conversions between Base 16, 8, 10, 2
3. Locates manufacturer's operating manual describing controller operations.
4. Studies logic concepts.
5. Identifies hardwired and programmed logic.
6. Locates and identifies operation of central processing unit.
7. Locates and identifies operations of the input, output system and peripheral devices.

COMPETENCY: Assemble, test and troubleshoot programmable controllers, and associated input output devices.

PERFORMANCE OBJECTIVE 1.b

TASK: Identify hardware components of programmable controllers including the central processing unit, the input/output system, programming and peripheral devices, and perform trouble shooting on the system.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of a written test and successful demonstration of system assembly and test as evidence by proper control system operation.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Programmable controller.
2. Input sensing capability.
3. Output control capability
4. Peripherial devices.
5. Manufacturer's specification and operating manual

PERFORMANCE GUIDE:

1. Locate manufacturer's operating and application documents.
2. Identify relationships between central processor and input, output devices (I/O).
3. Assemble the I/O devices using the desired application.
4. Test the controller and system operation.
5. Trouble shoot system operation.
6. Repair to manufacturer's specifications.

COMPETENCY: Understand, assemble, test and troubleshoot programmable controllers, components and systems.

PERFORMANCE OBJECTIVE 1.c

TASK: Install, start up, maintain, troubleshoot, and repair programmable controllers.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of a written test and successful demonstration of installation techniques and initial start up procedures of controller system as evidenced by supervisor and proper system operation.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Programmable controller
2. Input sensing capability
3. Output control capability
4. Peripherial devices
5. Manufacturer's specification and operating manual

PERFORMANCE GUIDE:

1. Locate manufacturer's operating and application documents.
2. Confer with supervisor and peers to discuss perameters of task.
3. Determine plan and schedule for project implementation.
4. Locate and assemble all components to accomplish the project.
5. Assemble the controller system.
6. Troubleshoot the controller system and modify as necessary.
7. Demonstrate operation to peers and supervisor.
8. Document system operation and provide troubleshooting techniques.

COMPETENCY: Understand, assemble, test and troubleshoot programmable controllers, components and systems.

PERFORMANCE OBJECTIVE 1.d

TASK: Understand computer software applications for programmable controllers, including programming languages, programming the controller, and documenting the system.

STANDARD OF PERFORMANCE OF TASK:

Satisfactory completion of written test. Satisfactory completion of written technical report describing system operation and troubleshooting procedures as specified by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Programmable controller
2. Input sensing capability
3. Output control capability
4. Peripherial devices

PERFORMANCE GUIDE:

1. Locate manufacturer's operating and application documents.
2. Recognize software application techniques for input and output sense and control.
3. Interpret and sythesize programming techniques to complete or modify controller task.

COMPETENCY: Assemble, test and troubleshoot pneumatic control components and systems.

PERFORMANCE OBJECTIVE 1.a

TASK: Know physical properties of compressable fluids: force transmission, Pascal's law, fluid pressure, mechanical force, and air preparation.

STANDARD OF PERFORMANCE OF TASK: Pass practical test as administered by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Pneumatic properties test

PERFORMANCE GUIDE:

COMPETENCY: Assemble, test and troubleshoot pneumatic control components and systems.

PERFORMANCE OBJECTIVE 1.b

TASK: Understands operation of pneumatic elements: palm valves, foot valves, limit valves and logic components such as relays (4 way, 5 part; spring return; detented relays; shuttle valves; multi flow-path; flow controllers; pumps, regulators and filters).

STANDARD OF PERFORMANCE OF TASK: Demonstrates understanding to satisfaction of supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Pneumatic elements test

PERFORMANCE GUIDE:

COMPETENCY: Assemble, test and troubleshoot pneumatic control components and systems.

PERFORMANCE OBJECTIVE 1.c

TASK: Applies air logic elements to system, process control and maintenance functions.

STANDARD OF PERFORMANCE OF TASK:

Passes a written or oral and/or practical test at a level of accuracy acceptable to the company or manufacturer's standards and/or instructors standards.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Pneumatic system
2. Operations and maintenance manuals
3. Test equipment
4. Applicable tools

PERFORMANCE GUIDE:

COMPETENCY: Assemble, test and troubleshoot pneumatic control components and systems.

PERFORMANCE OBJECTIVE 1.d

TASK: Troubleshoot, evaluate and repair air logic systems safely.

STANDARD OF PERFORMANCE OF TASK:

Passes a practical test identifying and isolating problem areas to respective level and sequence such as:

1. Symptom recognigition
2. System level
3. Subsystem level
4. Board level
5. Component level

as evidenced by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Pneumatic system
2. Operations and maintenance manuals
3. Test equipment
4. Applicable tools

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoot hydraulic control components and systems.

PERFORMANCE OBJECTIVE 1.a

TASK: Know physical properties of fluids and laws that govern fluid transmission.

STANDARD OF PERFORMANCE OF TASK: Pass practical test as administered by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Hydraulic properties test

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoot hydraulic control components and systems.

PERFORMANCE OBJECTIVE 1.b

TASK: Comprehends the control of fluid transmission, knowledge of fluid components and their basic individual operating principles: pressure relief valve, 2-2way valve, 3-2way valve, double-acting cylinder, check valve, throttle valve, two-way flow control valve, one way restrictor, 4-3 way valves, pumps, filters, pressure gauge, flow rate meters, pressure limiting valves.

STANDARD OF PERFORMANCE OF TASK: Demonstrates understanding to satisfaction of supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Hydraulic control and components test

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoot hydraulic control components and systems.

PERFORMANCE OBJECTIVE 1.c

TASK: Perform automated process control and maintenance procedures with hydraulic systems components.

STANDARD OF PERFORMANCE OF TASK:

Passes a written or oral and/or practical test at a level of accuracy acceptable to the company or manufacturers standards and/or supervisors standards.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Hydraulic system
2. Operations and maintenance manuals
3. Test equipment
4. Applicable tools

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoot hydraulic control components and systems.

PERFORMANCE OBJECTIVE 1.d

TASK: Troubleshoot, repair, and evaluate hydraulic control systems safely.

STANDARD OF PERFORMANCE OF TASK:

Passes a practical test identifying and isolating problem areas to respective level and sequence such as:

1. Problem identification
2. Symptom recognition
3. System level
4. Subsystem level
5. Board level
6. Component level

as evidenced by supervisor.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

1. Hydraulic system
2. Operations and maintenance manuals
3. Test equipment
4. Applicable tools

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.a

TASK: Determine the functional inter-relationships of parts within a mechanical system.

STANDARD OF PERFORMANCE OF TASK: 90th percentile scores.

SOURCE OF STANDARD: PAQ #81

CONDITIONS FOR PERFORMANCE OF TASK:

Conventional mechanical aptitude test; Bennet

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.b

TASK: Perceive detail to include color discrimination.

STANDARD OF PERFORMANCE OF TASK: Meets company policy.

SOURCE OF STANDARD: PAQ 20(4), 23

CONDITIONS FOR PERFORMANCE OF TASK:

Standard color and vision tests.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.c

TASK: Perceive pertinent details or configurations in a complex visual stimulus.

STANDARD OF PERFORMANCE OF TASK: Traces signals through diagram from input to output with 100% accuracy.

SOURCE OF STANDARD: PAQ 20(4), 3

CONDITIONS FOR PERFORMANCE OF TASK:

Complex logic diagram or schematic.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.d

TASK: Perform a task without significant loss in efficiency.

STANDARD OF PERFORMANCE OF TASK: Speed and quality of task performed meets or exceeds company standards.

SOURCE OF STANDARD: PAQ 16, 24, 25, 177

CONDITIONS FOR PERFORMANCE OF TASK:

Distracting or monotonous conditions.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.e

TASK: Identifies visual stimuli

STANDARD OF PERFORMANCE OF TASK: Interpretation of visual stimuli meets or exceeds company standards.

SOURCE OF STANDARD: PAQ 28, 29

CONDITIONS FOR PERFORMANCE OF TASK:

Standard perceptual speed test.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.f

TASK: Rapidly and accurately manipulate small objects.

STANDARD OF PERFORMANCE OF TASK: Manipulation of small objects meets or exceeds company standards.

SOURCE OF STANDARD: PAQ 17, 66, 68

CONDITIONS FOR PERFORMANCE OF TASK:

Standard hand/finger dexterity test.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.g

TASK: Interprets visual stimuli.

STANDARD OF PERFORMANCE OF TASK: Ninety percent (90%) score.

SOURCE OF STANDARD: PAQ 20(4), 4

CONDITIONS FOR PERFORMANCE OF TASK:

Spatial visualization test.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.h

TASK: Detect movement and assess speed and direction of objects.

STANDARD OF PERFORMANCE OF TASK: Estimates change in object position in a certain direction per unit of time meeting or exceeding local tolerances.

SOURCE OF STANDARD: PAQ 28, 29

CONDITIONS FOR PERFORMANCE OF TASK:

Reference point and an object.
Appropriate measuring devices.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.i

TASK: Discriminates part size, shape and texture by touch.

STANDARD OF PERFORMANCE OF TASK: Task performed meets or exceeds company standards.

SOURCE OF STANDARD: PAQ 17

CONDITIONS FOR PERFORMANCE OF TASK:

Assortment of parts in the work site.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits appropriate physical response when stimulated by a physical quantity.

PERFORMANCE OBJECTIVE 1.j

TASK: Demonstrate arm/hand position and steadiness.

STANDARD OF PERFORMANCE OF TASK: Task completed free of fatigue and in a steady manner.

SOURCE OF STANDARD: PAQ 81, 95, 98

CONDITIONS FOR PERFORMANCE OF TASK:

Task requiring arm/hand positioning and steadiness.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.a

TASK: Exhibit interest, perseverance, and patience.

STANDARD OF PERFORMANCE OF TASK: Manner in which the task was performed.

SOURCE OF STANDARD: Industry Objectives for Education: Task Force Report PAQ # 177, 172

CONDITIONS FOR PERFORMANCE OF TASK:

Work situations involving scientific methods.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.b

TASK: Maintain sensory alertness.

STANDARD OF PERFORMANCE OF TASK: Discriminates between wanted and unwanted sensory input with a low level of tension and irritability.

SOURCE OF STANDARD: Industry Objectives for Education: Task Force Report PAQ # 20(4), 23, 140, 177

CONDITIONS FOR PERFORMANCE OF TASK:

Highly distracting audio and/or visual environment.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.c

TASK: Exhibit interest and patience in applying and selecting scientific methods, problem-solving algorithms and/or systematic troubleshooting techniques independent of the social environment.

STANDARD OF PERFORMANCE OF TASK: Quality and speed of job performance meets or exceeds local standards.

SOURCE OF STANDARD: Industry Objectives for Education: Task Force Report PAQ# 37(3), 153(1), 177

CONDITIONS FOR PERFORMANCE OF TASK:

Job task.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.d

TASK: Exhibit scientific curiosity.

STANDARD OF PERFORMANCE OF TASK: Solution of the problem.

SOURCE OF STANDARD: Industry Objectives for Education: Task Force Report

CONDITIONS FOR PERFORMANCE OF TASK:

Natural phenomena in the work site.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.e

TASK: Follow instructions.

STANDARD OF PERFORMANCE OF TASK: Expected outcome meets actual outcome with zero deviation.

SOURCE OF STANDARD: PAQ # 172

CONDITIONS FOR PERFORMANCE OF TASK:

Specific set of instructions.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.f

TASK: Apply problem-solving methods.

STANDARD OF PERFORMANCE OF TASK: Completes task with sustained concentration and expected task is performed according to industry standards.

SOURCE OF STANDARD: PAQ # 173

CONDITIONS FOR PERFORMANCE OF TASK:

Time-limited specific task.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.g

TASK: Exhibit an interest or desire to work with tangible items.

STANDARD OF PERFORMANCE OF TASK: Product quality and quantity meets or exceeds local standards.

SOURCE OF STANDARD: Industries Objectives for Education: Task Force Report

CONDITIONS FOR PERFORMANCE OF TASK:

Material elements or parts used to construct a product.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.h

TASK: Exhibit interest and concern with the systematic application of problem-solving techniques and preventive maintenance activities used to troubleshoot algorithms or sequences.

STANDARD OF PERFORMANCE OF TASK: Workers ability to perform complex tasks involving troubleshooting algorithms or sequences.

SOURCE OF STANDARD: Industries Objectives for Education: Task Force Report

CONDITIONS FOR PERFORMANCE OF TASK:

Operation defined by set procedures or sequences.

PERFORMANCE GUIDE:

COMPETENCY: Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

PERFORMANCE OBJECTIVE 1.i

CONDITIONS FOR PERFORMANCE OF TASK:

A task and an aesthetic reference.

TASK: Evaluates aesthetic quality of performance against known reference.

STANDARD OF PERFORMANCE OF TASK: Workmanship of task meets or exceeds locally accepted standard reference.

SOURCE OF STANDARD: Industries Objectives for Education: Task Force Report

PAQ # 31
Writing team

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.a

TASK: Interface with professional and semiprofessional personnel to gather and exchange information with which to schedule and coordinate maintenance time for electrical and mechanical systems.

STANDARD OF PERFORMANCE OF TASK: Obtains needed information required to perform the required maintenance as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: VI PAQ 105 116 117 132

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturer Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance and information exchange with professional and semiprofessional personnel.

PERFORMANCE GUIDE:

1. Set time for meeting.
2. State reason for meeting.
3. Ask direct questions about information needed.
4. Make notes after meeting in response to questions.
5. Review notes to assure understanding of answers.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.b

TASK: Kneel/stoop to get under, over, behind equipment being worked on.

STANDARD OF PERFORMANCE OF TASK:

Perform maintenance to the manufacturer's specification on equipment which has limited accessibility as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 92

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturer Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance with limited accessibility.

PERFORMANCE GUIDE:

1. Turn on test equipment.
2. Remove panels.
3. Open schematics.
4. Turn on equipment under test.
5. Make repairs.
6. Replace panels.
7. Check stationary equipment for proper operation.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.c

TASK: Provides staff development to designated personnel.

STANDARD OF PERFORMANCE OF TASK: Trains personnel to use equipment as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: VI PAQ 102

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturer Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Set time of training.
2. Specify type of training.
3. Provide equipment, materials and literature.
4. State objective of training.
5. Perform required training.
6. Evaluate effectiveness of training.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.d

TASK: Applies mathematical concepts to solve technical problems.

STANDARD OF PERFORMANCE OF TASK: Make electronic measurements and calculate the results as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: II PAQ 42

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications.
2. Take electrical measurements.
3. Calculate results.
4. Compare results against specification.
5. Make necessary repair or adjustment.
6. Write a report describing action taken.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.e

TASK: Use physical measuring devices to find distance, spaces and RPM.

STANDARD OF PERFORMANCE OF TASK: Perform physical measurements and adjustments to meet manufacturers' specifications as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 58

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications.
2. Make measurements as required.
3. Check measurements against specification.
4. Repair or adjust as necessary.
5. Write report on work accomplished.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.f

TASK: Use hand operated controls to make frequent adjustments on test equipment.

STANDARD OF PERFORMANCE OF TASK: Interpret equipment operation and predict response of system as individual hand operated controls are adjusted in a sequence as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 66

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Turn on test equipment and let it warm up.
2. Turn on equipment under test.
3. Adjust equipment over range of operation.
4. Use test equipment over range of operation to verify operation of equipment under test.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.g

TASK: Use computer diagnostic programs for accessing equipment or system status.

STANDARD OF PERFORMANCE OF TASK: Compare the results of the computer diagnostic printout and the manufacturers' maintenance manual as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: II PAQ 48

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.
Computer Diagnostic printout.

PERFORMANCE GUIDE:

1. Check specifications.
2. Check computer diagnostic printout.
3. Compare printout and specifications.
4. Write report on results.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.h

TASK: Work under improper illumination conditions.

STANDARD OF PERFORMANCE OF TASK: Electronic equipment and machines will be returned to the manufacturers' specifications as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3)System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: V PAQ 140

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.
Improperly illuminated area.

PERFORMANCE GUIDE:

1. Setup improper illumination.
2. Check specifications.
3. Turn on test equipment.
4. Turn on equipment under test.
5. Test for defects.
6. Remove and replace all defects as necessary.
7. Adjust or align if necessary.
8. Check for proper operation.
9. Write report of action taken.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.i

TASK: Gathers data from equipment performance to analyze equipment problems (smell, sight, sound, testing, etc.)

Subtask: Combines information from two or more sources to establish new information/fact.

STANDARD OF PERFORMANCE OF TASK: Gathers data from various sources, organizes and interprets data to establish possible problem areas as evidenced by passing a test, identifying and isolating problem solving areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: II PAQ 40 39

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Refer to task 3.j and 3.k.
2. Check specification.
3. Gather data and identify symptoms of trouble.
4. Correlate data to determine possible cause of breakdown.
5. Retest probable area of component or system inoperation.
6. Repair and align to manufacturers' or company's specification.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.J

TASK: Uses sensory means to answer technical problems (smell, touch, visual and auditory).

STANDARD OF PERFORMANCE OF TASK:

1. Determine by smell overheated or burned out resistors and transformers.
2. Determine by touch if components are excessively hot.
3. Interpret data and assess performance of equipment by indicator lights, visual inspection, audible alarms and unusual noises ... as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: I PAQ 16 17 23 25

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Visual inspection of equipment.
2. Listen for unusual noise or audible alarms.
3. Smell for overheated components.
4. Touch for overheated components.
5. Assess data obtained.
6. Repair as needed.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.k

TASK: Interpret symbols.

STANDARD OF PERFORMANCE OF TASK: Using computer read outs and/or monitors, interpret data to establish problem areas as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: II PAQ 42

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Obtain computer printout or use computer display.
2. Interpret coding and decoding from computer information.
3. Check specifications against computer data.
4. Make necessary repairs or adjustments.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.1

TASK: Use technical apparatus to time, calculate and count events.

STANDARD OF PERFORMANCE OF TASK: Detects variations from normal operations using timing and calculating devices as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 59

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specification.
2. Turn on test equipment and let it warm up.
3. Turn on equipment under test.
4. Perform measurement.
5. Calculate data.
6. Check equipment for proper operation.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.m

TASK: Use power driven precision and non-power driven precision tools to perform operations requiring accuracy.

STANDARD OF PERFORMANCE OF TASK: Operate power and nonpower precision tools to perform task required as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 50 55

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications.
2. Use power driven precision tools to perform task.
3. Check for compliance to specifications.
4. Use nonpower driven precision tools to perform a task.
5. Check for compliance to specifications.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.n

TASK: Use precision instruments to perform accurate or precise operations or measurements.

STANDARD OF PERFORMANCE OF TASK: Make precision measurements on machinery or equipment as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence 1) Problem Identifiction, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceed company standards.

SOURCE OF STANDARD: III PAQ 50

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications.
2. Turn equipment/machinery on.
3. Run through one cycle of operation.
4. Observe operation.
5. Make measurements.
6. Adjust or align if necessary.
7. Check equipment/machinery for proper operation.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.o

TASK: Use transducers to detect unusual odor, temperature and moisture situations.

STANDARD OF PERFORMANCE OF TASK: Detection of variation from normal operations as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: I PAQ 18

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Turn test equipment on.
2. Take instrument readings.
3. Interpret data.
4. Check specification.
5. Repair or restore equipment to specification as required.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.p

TASK: Traces circuit functions using pictorial representations.

STANDARD OF PERFORMANCE OF TASK: Trace circuit functions through pictorial diagrams, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD:

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.q

TASK: Use variable setting controls to change operational limits on equipment and machinery.

STANDARD OF PERFORMANCE OF TASK: Adjust equipment and machinery with variable control that regulates operational limits in accordance with manufacturers' specifications, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 64

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications.
2. Turn on equipment and let it warm up if necessary.
3. Adjust controls to proper operational limits.
4. Check equipment for proper operation.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.r

TASK: Sets up, adjusts and calibrates machines and equipment to meet required specifications.

STANDARD OF PERFORMANCE OF TASK: Setup, adjust and calibrate machines and equipment to meet manufacturers' specifications, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 78

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Turn on test equipment.
2. Check specifications.
3. Turn on machine or equipment.
4. Calibrate.
5. Make final adjustments.
6. Check against specifications.
7. Write a report on work accomplished.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.s

TASK: Differentiate objects and details at normal working distance.

STANDARD OF PERFORMANCE OF TASK: Differentiate objects and details, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: I PAQ 20

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specification.
2. Disassemble equipment.
3. Repair or adjust as necessary.
4. Reassemble equipment.
5. Check equipment against specifications.
6. Write report on work accomplished.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.t

TASK: Disassemble and assemble equipment and machines to conduct necessary repair and maintenance.

STANDARD OF PERFORMANCE OF TASK: Disassemble, repair and assemble equipment with all interlocks and safety devices in place and operating, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 81

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic Equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Check specifications and safety procedures.
2. Test to determine cause of problem.
3. Locate disassembly intructions in manual and follow procedures, disassemble equipment and make repairs.
4. Locate assembly intructions in manual, follow procedures and reassemble equipment.
5. Check operating performance against specifictions.
6. Write a report on work accomplished.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.u

TASK: Sets dials, gauges and lights using visual displays.

STANDARD OF PERFORMANCE OF TASK:

1. Set dials to correct position.
2. Set gauges with appropriate control.
3. Set indicator lights with appropriate controls, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3)System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: I PAQ 5

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Turn test equipment on.
2. Check specifications.
3. Set calibrated dials.
4. Set gauges.
5. Check and set visual indicator.
6. Check equipment against specifications.
7. Repair or calibrate as needed.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.v

TASK: Interpret the condition of circuits using various measuring devices.

STANDARD OF PERFORMANCE OF TASK: Inject an input signal and trace it through the circuit to the output, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: I PAQ 6

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.

PERFORMANCE GUIDE:

1. Turn test equipment on.
2. Check specifications.
3. Inject signals where appropriate.
4. Trace signal through the circuit.
5. Check each step against expected result.
6. Write a report on work accomplished, indicating result of test sequence.

COMPETENCY: Troubleshoots and repairs electronic equipment to insure proper operations.

PERFORMANCE OBJECTIVE 1.w

TASK: Test and troubleshoot electronic circuitry and sub-assembly for environmental defects.

STANDARD OF PERFORMANCE OF TASK: Troubleshoot and repair electronic circuit or sub-assembly under a specific environmental condition, as evidenced by passing a test, identifying and isolating problem areas to respective level and sequence such as: 1) Problem Identification, 2) Symptoms, 3) System Level, 4) Subsystem Level, 5) Board Level, and 6) Component Level which meets or exceeds company standards.

SOURCE OF STANDARD: III PAQ 137

CONDITIONS FOR PERFORMANCE OF TASK:

Manufacturers' Maintenance and Operations Manual.
Necessary hand tools.
Test equipment as required.
Electronic equipment or systems requiring maintenance.
Environmental chamber.

PERFORMANCE GUIDE:

1. Check specifications.
2. Turn on test equipment and let it warm up.
3. Turn on environmental chamber and let it operate at proper environment.
4. Turn on circuit or sub-assembly and let it operate in proper environment.
5. Test for defects.
6. Replace any defective component.
7. Align and calibrate if necessary.
8. Check for proper operation.
9. Document work accomplished.

APPENDICES

RESOURCES

Electronics

Anastasi, Thomas E., Jr., Listen! Techniques For Improving Communication Skills, CBI Publishing Co., Inc., 1982.

Anastasi, Thomas E., Jr. and Sidney A. Dimond, Listening On The Job, Addison-Wesley Publishing Co., 1972.

Barbara, Dominick, How To Make People Listen To You, Charles C. Thomas, 1971.

Barker, Larry and Renee Edwards, Intrapersonal Communications, Gorsuch Scarlsbrick Publishers, 1980.

Cannon, Don L., Understanding Digital Troubleshooting, Texas Instruments, 1984.

Cannon, Don L., and Gerard Lueuce, Understanding Microprocessors, Texas Instruments, 1984.

Coffron, James W., Practical Hardware Details For The 8080, 8085, 280 and 6800, Prentice-Hall, 1981.

Coffron, James W., Understanding and Troubleshooting Microprocessors, Prentice-Hall, 1980.

Davidson, Homer L., Troubleshooting The Solid State Chassis, Tab Books, Inc., 1969.

Deere and Company, Hydraulics, 1st Edition, Service Training Department, John Deere Road, Moline, IL 61265; STUDENT WORKBOOK FCP-82301W, no date.

Del Polito, Carolyn M., Intrapersonal Communication, Cummings Publishing Co., 1977.

Dynamco Inc., "Air Logic Control Components, Dynamco Inc., 2639 Manana Drive, Dallas, TX 75220, 1983.

Elsea, Janet, The Four Minute Sell: A Communication Guide To First Impressions, Simon and Schuster, 1984.

Geeting, Baxter and Corrine, How To Listen Assertively, International Society for General Sematics, 1976.

Glatthorn, Allan A. and Herbert R. Adams, Listening You Way To Management Success, Scott, Foresman, 1983.

Resources - Continued

Goodman, Robert L., Troubleshooting With The Dual Trace Scope, Tab Books, Inc., 1976.

Gordon, Thomas, Leader Effectiveness Training, Wyder Books, 1977.

Green, Michael and Ario Turk, Safety In Working With Chemicals, MacMillan Publishing Co., New York, 1978.

Grob, Beamont, Basic Electronics, 5th Edition, McGraw-Hill Book Co., New York, 1984.

Harris, Norman C. and Edwin M. Hemmerling, Introductory Applied Physics, 4th Edition, McGraw-Hill Book Co., 1980.

Heathkit Educational Systems, Laser Technology, Heath Co., Benton Harbor, Michigan, 1985.

Howell, William Smiley, The Empathic Communicator, Wadsworth Publishing Co., 1982.

Jenkins, Francis A. and Harvey E. White, Fundamentals of Optics, McGraw-Hill Book Co., 1950.

Jones, C. T. and L. A. Bryon, Programmable Controllers: Concepts and Applications, IPC/ASTEC Publication, 1983.

Kershaw, John D., Digital Electronics: Logic and Systems, 2nd Edition, Breton Publishers, 1983.

Larson, Carl V., Persuasion: Reception and Responsibility, Wadsworth Publishing Co., 1978.

Leach, Donald P., Basic Electric Circuits, 3rd Edition, Wiley-Interscience, 1984.

Long, Lynette, Listening/Responding: Human-Relations Training For Teachers, Cole Publishing Co., 1978.

Malvino, Albert P., Digital Computer Electronics, 2nd Edition, McGraw-Hill Book Co., 1981.

Malvino, Albert P., Digital Principles and Applications, 3rd Edition, McGraw-Hill Book Co., 1981.

Malvino, Albert P., Electronic Principles, 2nd Edition, McGraw-Hill Book Co., 1979.

Malvino, Albert P., Resistive and Reactive Circuits, McGraw-Hill Book Co., 1974.

Resources - Continued

Malvino, Albert P., Transistor Circuit Approximations, 3rd Edition, McGraw-Hill Book Co., 1980.

Margolis, Art, Troubleshooting and Repairing Personal Computers, Tab Books, Inc, 1983.

Merrill, Bob, Electronic Troubleshooting, 1984.

National Research Council, Prudent Practices For Handling Hazardous Chemicals in Laboratories, National Academy Press, 1981.

Offenbeck, John, Microcomputers and Microprocessors, Prentice-Hall, 1985.

OSHA, Encyclopedia Of Occupational Safety and Health, 2 volumes, International Labor Office, Geneva, McGraw-Hill Book Co., New York, 1971.

Parker Fluid Power, Industrial Pneumatic Technology Bulletin 0275-B1, Cleveland, OH, 1980.

Perozzo, James, Practical Electronics Troubleshooting, Delmar, 1985.

Roth, Charles H., Fundamentals of Logic Design, 3rd Edition, West Publishing Co., 1985.

Royal Society of Chemists, Hazards In The Chemical Lab, edited by L. Bretherice, 3rd Edition, 1981.

Steere, Norman, editor, Handbook of Laboratory Safety, Latent edition, Chemical Rubber Co., Cleveland, Ohio.

Tocci, Ronald J., Digital Systems: Principles and Applications, 3rd Edition, Prentice-Hall, 1985.

Washington, Allen, Basic Technical Mathematics.

EQUIPMENT LISTS

Equipment identified, in the PAQ, by workers as being important in th performance of their tasks. Proper use, operating techniques and application of each item were emphasized.

ELECTRONIC	HAND TOOLS	MACHINE TOOLS
Computers	Jeweler Drill	Machinist Tools
Tools		
	Tweezer	Rule
CPU	Jump Leads	Gauge
Controllers	Test Leads	LUDT Gauge
Magtape Units	Pliers/Screwdrivers	Force Gauge
Video Terminal	Wrenches	Fisler Gauge
Card Reader	Allen/Bristol	Micrometer
I/O Units	Electric Drills	Feeler Gauge
Printers	Grinders	Center of
Card/Tape Punch	Sockets	Curvature Tool
Modem	Torque Wrench	Scales
	Board Puller	Height Gauge
	Solder Tools	Grom Gauge
ETLT. Lab	Calculators	Calipers
	Spring Hook	Band Saw
Oscilloscope	Eye Lupes	Lathe
Multi-tracer	Q-tips	Mill, Vertical
Curve-tracer	Kim Wipes	Pressure Gauge
VOM	X-Acto Knife	Go/No Go Gauge
DVOM	Hand Saw	
Freq. Counter	Saber Saw	
Test Leads	Heat Gun	
DIP Clips	Dollies/Hoists	
Logic Probes	Pipe Fitting Tools	
Spectrum Analyzer	Rules	
Power Supply	Flashlight	
Strip Chart Recorders	Mirror	
(x-y)	Stop Watch	
Logic Analyzer	Lugs/Fixtures	
Network Analyzer	Hemostats	
Tape Recorder	Wire Strippers	
A-V Equipment	Cutters	
Generators	Sanders	
AC/DC/Pulse/Function	Air Compressors	
Temperature Chambers	T-V Monitor	
Mfg. Data Manuals		

EQUIPMENT LIST (continued)

SPECIAL

Microfiche
Ultratech Stripper
Perkins Elmer
Aligner
Bel Stereo
Microscope
PMT Microscope
Light Monitor
Ramp to Slit
Alignment Tool
Drafting Tools
CAD Workstation
Operations
High Voltage Methods
Cameras/Film
Solvents/Cleaning
Materials
Hydraulic Test
Monitor Gauges
Pneumatic Test
Monitor Gauges
Optical Test Monitor
Gauges

Basic Equipment identified by Curriculum Academy participants found in typical Community College and some high school laboratories:

Oscilloscope: Multi-tracer
Power Supplies: AC and DC
Volt, Ohm, Milliameter
Digital Volt, Ohm, Milliameter
Function generator
Pulse generator

Appendix C

BASIC CONCEPTS OF AUTOMATION
FOR ENTRY LEVEL ELECTRONICS TECHNICIANS*

BASIC SKILLS	KEYBOARD DEVICES	MATH ALGEBRA GEOMETRY	COMMUNICATION WRITTEN VERBAL READING VACUUM	AUTOMATED TECHNOLOGY MECHANICAL LIGHT HEAT		HYGIENE SAFETY
TECHNICAL SKILLS	ELECTRONICS ANALOG	PROGRAMMABLE CONTROLLERS	OPTICS PHYSICAL GEOMETRIC LASER FIBER	PNEUMATICS	HYDRAULICS	PERSONALITY and PHYSICAL SKILLS
TROUBLESHOOT SKILLS	MAINTAIN	REPAIR	ADJUST	ALIGN		

* Data for chart obtained from source documents and consensus of curriculum academy participants. Source documents are the Industry study "Data for Public School Curriculum Development: An Electronics Industry Skills Analysis for Education Objective" and "Electronics Curriculum Planning Guide for the 1980's and 1990's".

INDUSTRIAL TRAINING PROGRAM

"Controls and Automation"

Job Competency Requirements
(Industry selected PAQ Questions Used in the Study)

Category I PAQ	INFORMATION INPUT
#29	Estimating Spped of Moving Parts
#25	Sound Differentiation
#24	Sound Pattern Recognition
#23	Color Perception
#19	Taste
#18	Odor
#17	Touch
#16	Nonverbal Sounds
# 5	Visual Displays
#31	Judging Condition/Quality
# 3	Pictorial Materials
# 4	Patterns/Related Devices
# 7	Mechanical Devices
# 6	Measuring Devices

Category II PAQ	MENTAL PROCESSES
#48	Training
#42	Coding/Decoding
#40	Analyzing Information or Data
#39	Combining Information (Synthesis)
#37	Reasoning in Problem Solving

Category III PAQ	WORK OUTPUT
#95	Hand-Arm Steadiness
#92	Kneeling/Stooping
#83	Feeding/Off-Bearing
#81	Assembly/Disassembly
#80	Material Controlling
#78	Setting up/Adjusting
#68	Hand Operated Controls
#65	Keyboard Devices
#64	Variable Setting Controls
#63	Fixed Setting Controls
#62	Activation Controls
#61	Machines/Equipment

INDUSTRIAL TRAINING PROGRAM continued:

#59	Technical and Related Devices
#55	Non-precision Tools/Instruments
#54	Precision Tools/Instruments
Category IV PAQ	OTHER JOB CHARACTERISTICS
#185	General Responsibility
#177	Vigilance
#173	Time Pressure of Situation
Category V PAQ	JOB CONTEXT
#153	Non-Job-Required Social Contact
#142	Awkward or Confining Work Space
#140	Improper Illumination
#138	Air Contamination
#137	Low Temperature
Category VI PAQ	RELATIONSHIP WITH OTHER PERSONS
#132	Coordinates Activities
#117	Semiprofessional Personnel
#116	Professional Personnel
#102	Instructing
#100	Negotiating

ACADEMY PARTICIPANTS, CONSULTANTS AND INDUSTRY TASK FORCE MEMBERS

* * * * * * Educational Task Force Members * * * * * *

Renault Catalano
Glendale Community College
5128 N. 81st Drive
Glendale, AZ 85303

Roy Harrington
Deer Valley High School
5446 W. Pointsettia
Glendale, AZ 85304

Rick Peters
Eastern Arizona College
1311 1st Avenue
Safford, AZ 85546

Robert Cullifoer
Mess Vo-Tech
1948 E. Inglewood
Mesa, AZ 85203

Ron Moody
Pima Community College
2231 W. San Marcos
Tucson, AZ 85713

* * * * * * Industrial Task Force Members * * * * * *

Tom DeShong
National Semiconductor

Tom Orton
Intel
6501 W. Williams Field Road
Chandler, AZ 85224

Ed Dispain
Honeywell

Ed Petrosky
National Semiconductor

Len Wright
Honeywell

Murry Allen
Motorola

* * * * * * Project Leaders * * * * * *

Richard Bernstein, Ph.D.
William Rainey Harper College
Alonquin and Roselle Roads
Palatine, IL 60067
(312)397-3000 ext. 528

Roger Mussell, Ph.D.
William Rainey Harper College
Alonquin and Roselle Roads
Palatine, IL 60067
(312)397-3000

PARTICIPANTS/CONSULTANTS/INDUSTRY TASK FORCE MEMBERS (Cont'd)

* * * * * * Project Consultants * * * * * *

Barbara Gutheil, Ph.D.
Arizona Center for Vocational Education

Charlotte Prickett
Arizona Center for Vocational Education

Linda Loomis, Ph.D.
Arizona Center for Vocational Education

Kathy Dunn
Arizona Center for Vocational Education

* * * * * * Administration * * * * * *

Robert Kerwood, Ph.D.
Director, Arizona Center for Vocational Education

Don Parsons, Manager
Arizona Center for Vocational Education

	MATH			KEYBOARD			COMMUNICATION SKILLS			PHYSICAL			RESPONSIBILITY SKILLS	REFERENCES	COMMUNICATION REFERENCES
	GEN	ALG	GEO	TYPE	CAL	TERMINAL	WRITTEN	VERBAL	READING	MECH	LIGHT	HEAT			
ANALOG	X	X	X	X	X	X	X	X	X	X	X	X		19, 28, 32 33, 46	1, 2, 3, 17
DIGITAL	X	X		X	X	X	X	X	X	X	X	X		5,6,7,8,25, 30,31,34,42, 45,46	4,11,17
SAFETY	X			X	X	X	X	X	X	X	X	X		18, 37, 39, 43, 44	17, 13
HYGIENE	X						X	X	X	X	X	X		39, 43, 41	13, 14
OPTICS	X	X	X		X		X	X	X		X	X		24, 22, 21, 20, 46	15, 17
PNEUMATIC	X	X	X		X	X	X	X	X	X		X		40	17, 23, 27
PROGRAMMABLE CONTROLLER	X	X		X	X	X	X	X	X	X		X		25, 46	17, 29
PHYSICAL SKILLS	X			X	X	X	X	X	X	X				46	17
TROUBLESHOOTING	X	X	X	X	X	X	X	X	X	X	X	X		5, 8, 9, 16, 35, 36 38, 41	17

SUMMARY OF COMPETENCIES AND TASKS

BASIC SKILLS

1. Operates keyboard devices.

   a. Type at 35 wpm.
   b. Perform calculations efficiently and correctly at 25 strokes per minute.
   c. Enter 52 keystrokes per minute.

2. Apply math skills to solve problems.

   a. Solve general math problems.
   b. Solve algebraic problems.
   c. Solve geometry problems.

3. Demonstrate written and verbal communication skills.

   a. Orally present material to an individual or group.
   b. Exhibit 10th grade writing skills.

4. Demonstrate reading comprehension skills.

   a. Exhibit 10th grade reading comprehension skills.

5. Know basic concepts of automated technology.

   a. Comprehends basic mechanical properties relating to force, motion, energy and torque.
   b. Comprehend basic properties of light: reflection, refraction, dispersion and diffraction.
   c. Comprehends temperature, heat and the three forms of heat transfer: conduction, convection and radiation.
   d. Comprehend gas laws applied to vacuum applications utilizing pumps, components and systems.

ANALOG

1. Evaluate, analyze and apply circuit theorems and laws to resistive electrical circuits using general mathematics.

   a. Determine operating values by applying circuit theorems and laws.
   b. Simplify circuits by using Thevenin's theorem.

SUMMARY OF COMPETENCIES AND TASKS continued:

ANALOG continued:

c. Simplify circuits by using Norton's theorem.
d. Analyze circuits that have more than one voltage or current source using superposition theorem.

2. Evaluate and analyze electric circuits using right triangle trigonometry.

a. Calculate impedance of series and parallel AC circuits.
b. Evaluate complex electric circuits to determine operating values.

3. Evaluate and analyze DC and AC electric circuits using phasor algebra.

a. Calculate phase shift of AC circuits parameters.
b. Calculate amplitude levels of AC voltage and currents.

4. Measure circuit gain, frequency response and determine power dissipation of active circuits or sub-systems.

a. Measure gain of an amplifier circuit using numeric ratio and decibels.
b. Measure circuit or system frequency response.
c. Observe and note changes in waveforms.

5. Write technical reports documenting corrective action procedures.

a. Collect and record data.
b. Write corrective action reports.

6. Sketch schematics and pictorials of circuit layouts and test setups.

a. Sketch circuit schematics.
b. Sketch pictorial layouts of:
   1. Components and placement
   2. Test set ups
   3. Assembly modifications

SUMMARY OF COMPENTENCIES AND TASKS continued:

ANALOG continued:

7. Construct circuits, sub-assemblies and systems from schematics, pictorials, wire and component lists.

   a. Check component lists against schematics.
   b. Interpret wire lists.
   c. Assemble products using schematics and pictorial drawings.

8. Audit product performance by using production change orders and test specification sheets.

   a. Verify product performance.

9. Classify component quality by measuring their physical and electrical properties.

   a. Visually inspect components.
   b. Verify physical size.
   c. Test electrical properties.
   d. Sort and categorize components by environmental, physical, and electrical tolerances.

10. Identify active circuit configuration.

   a. Recognize basic circuit types.

11. Analyze devices using manufacturers' data sheets.

   a. Determine device characteristics.
   b. Bias active devices for typical operation.

12. Use power sources and grounding techniques to ensure proper system performance.

   a. Test and evaluate power supplies.
   b. Determine the difference between chassis and neutral ground.
   c. Monitor power sources electronically.
   d. Ground circuit, sub-assembly, and systems.

SUMMARY OF COMPETENCIES AND TASKS continued:

DIGITAL

1. Analyze combinatorial logic circuits.

   a. Identify logic gates.
   b. Trace logic levels.
   c. Interpret truth tables.
   d. Interpret ladder diagram.

2. Analyze sequential logic circuits.

   a. Identify flip-flops and multivibrators.
   b. Identify simple and complex counters.
   c. Identify clock circuit characteristics.
   d. Trace logic levels.
   e. Interpret timing and control.

3. Analyze combinatorial logic circuits.

   a. Discriminate between digital circuit and a computer circuit.
   b. Identify the microprocessor.
   c. Identify the support chips.
   d. Identify bus structure and I/O.
   e. Interpret related timing and control diagrams.
   f. Trace logic levels.

4. Analyze peripheral devices.

   a. Identify peripheral chips.
   b. Identify interfacing process.

5. Test and measure digital logic circuits.

   a. Test and measure combinatorial logic circuits.
   b. Test and measure sequential logic circuits.
   c. Test and measure microprocessor-based logic circuits.

6. Program a dedicated microprocessor.

   a. Identify binary, hexadecimal, octal numbers.
   b. Recognizes the difference between the addressing structures in a particular microprocessor.
   c. Writes a program, knows and identifies the programming model of a microprocessor.

SUMMARY OF COMPETENCIES AND TASKS continued:

SAFETY

2. Observe and follows personal and plant safety requirements.

   a. Practice respiratory protection.
   b. Practice eye protection.
   c. Practice ear protection.
   d. Practice nose protection.
   e. Practice skin protection methods.
   f. Practice foot protection methods.

1. Observes and follows personal safety and plant requirements.

   a. Distinguish long and short term toxicity affects.
   b. Reduces air contamination.
   c. Reduces chemical hazard.
   d. Reduces personal contamination and injury.
   e. Avoid electrical shock.
   f. Works with one hand while working on energized electrical equipment.
   g. Avoid overloading circuits.
   h. Remove jewelry.
   i. Identify hazard warning signs.
   j. Practice fire safety.
   k. Operate hand tools safely.
   l. Operate power tools safely.
   m. Avoids bypassing safety devices.
   n. Practices standard grounding techniques at all power feed points to reduce shock hazard.
   o. Insures that all power feed switches are in the off position.

HYGIENE

1. Follows personal hygiene practices for working in industry.

   a. Know personal body functions and related cleanliness.
   b. Follows personal hygiene practices regarding body hair.
   c. Wears appropriate clothing.

2. Knows hygiene requirements of the working environments in the Electronics Industry.

   a. Know general plant hygiene requirements by area: office, factory, shipping, field environments.
   b. Know hygiene related handling of chemicals.
   c. Know waste disposal techniques.
   d. Know office hygiene procedures.

HYGIENE continued:

e. Know factory hygiene methods (Warehouse, general factory, semi-clean room, clear room).
f. Know packaging hygiene for manufacturing processes.

OPTICS

1. Uses Physical Optics to perform alignment of electromechanical - optical systems.

   a. Operate and maintain optical testing and measuring instruments:
      A. OAI Light Monitor
      B. Eye Lupes
      C. Light Intensity Meter
      D. Optical Cleaning Materials

2. Use geometric optics to perform servicing and alignment procedures on automated test equipment.

   a. Comprehend and apply the properties of lenses in the use of optical equipment.
   b. Operate a Bell stereo microscope for observation of semiconductor substrate physical characteristics.
   c. Perform manufacturers' specified maintenance on optical equipment in automated testing systems.

3. Use laser to perform selected industrial manufacturing processes.

   a. Follow safety guidelines when working with lasers.
   b. Measure distances and angles using lasers.
   c. Cut, drill and weld with lasers.
   d. Evaluate, troubleshoot and repair a basic laser system.

4. Troubleshoot fiber optic control systems.

   a. Identify faulty components and measure parameters used in fiber optics communication systems.
   b. Troubleshoot and repair minor problems in short link fiber optic communication systems: Simplex, Half Duplex and Full Duplex.

SUMMARY OF COMPETENCIES AND TASKS continued:

PROGRAMMABLE CONTROLLERS

1. Assemble, test and troubleshoot programmable controllers, and associated input output devices.

    a. Use basic numbering systems, codes and logic concepts of programmable controllers.
    b. Identify hardware components of programmable controllers including the central processing unit, the input/output system, programming and peripheral devices, and perform troubleshooting on the system.

2. Understand, assemble, test and troubleshoot programmable controllers, components and systems.

    a. Install, start up, maintain, troubleshoot, and repair programmable controllers.
    b. Understand computer software applications for programmable controllers, including programming languages, programming the controller, and documenting the system.

PNEUMATIC CONTROLS

1. Assemble, test and troubleshoot pneumatic control components and systems.

    a. Know physical properties of compressable fluids: force transmission, Pascal's law, fluid pressure, mechanical force, and air preparation.
    b. Understands operation of pneumatic elements: palm valves, foot valves, limit valves and logic components such as relays (4 way, 5 part; spring return; detented relays; shuttle valves; multi flowpath; flow controllers; pumps, regulators and filters).
    c. Applies air logic elements to system, process control and maintenance functions.
    d. Troubleshoot, evaluate and repair air logic systems safely.

HYDRAULIC CONTROLS

1. Troubleshoot hydraulic control components and systems.

    a. Know physical properties of fluids and laws that govern fluid transmission.

HYDRAULIC CONTROLS continued:

b. Comprehends the control of fluid transmission, knowledge of fluid components and their basic individual operating principles: pressure relief valve, 2-2way valve, 3-2way valve, double-acting cylinder, check valve, throttle valve, two-way flow control valve, one way restrictor, 4-3 way valves, pumps, filters, pressure gauge, flow rate meters, pressure limiting valves.
c. Perform automated process control and maintenance procedures with hydraulic systems components.
d. Troubleshoot, repair, and evaluate hydraulic control systems safely.

PHYSICAL SKILLS

1. Exhibits appropriate physical response when stimulated by a physical quantity.

   a. Determine the functional inter-relationships of parts within a mechanical system.
   b. Perceive detail to include color discrimination.
   c. Perceive pertinent details or configurations in a complex visual stimulus.
   d. Perform a task without significant loss in efficiency.
   e. Identifies visual stimuli.
   f. Manipulates small objects.
   g. Iinterprets visual stimuli.
   h. Detect movement and assess speed and direction of objects.
   i. Discriminates part size, shape and texture by touch.
   j. Demonstrate arm/hand position and steadiness.

PERSONALITY SKILLS

1. Exhibits specialized personality skills/traits and employs appropriate social awareness to achieve a job task.

   a. Exhibit interest, perseverance, and patience.
   b. Maintain sensory alertness.
   c. Exhibit interest and patience in applying and selecting scientific methods, problem-solving algorithms and/or systematic troubleshooting techniques independent of the social environment.
   d. Exhibit scientific curiosity.
   e. Follow instructions.
   f. Apply problem-solving methods.
   g. Exhibit an interest or desire to work with tangible items.

SUMMARY OF COMPETENCIES AND TASKS continued:

PERSONALITY SKILLS continued:

h. Exhibit interest and concern with the systematic application of problem-solving techniques and preventive maintenance activities used to troubleshoot algorithms or sequences.
i. Evaluates aesthetic quality of performance against known reference.

TROUBLESHOOTING

1. Troubleshoots and repairs electronic equipment to insure proper operations.

   a. Interface with professional and semiprofessional personnel to gather and exchange information with which to schedule and coordinate maintenance time for electrical and mechanical systems.
   b. Kneel/stoop to get under, over, behind equipment being worked on.
   c. Provides staff development to designated personnel.
   d. Applies mathematical concepts to solve technical problems.
   e. Use physcial measuring devices to find distance, spaces and RPM.
   f. Use hand operated controls to make frequent adjustments on test equipment.
   g. Use computer diagnostic programs for accessing equipment or system status.
   h. Work under improper illumination conditions.
   i. Gathers data from equipment performance to analyze equipment problems (smell, sight, sound, testing, etc.)
   j. Uses sensory means to answer technical problems (smell, touch, visual and auditory).
   k. Interpret symbols.
   l. Use technical apparatus to time, calculate and count events.
   m. Use power driven precision and non-power driven precision tools to perform operations requiring accuracy.
   n. Use precision instruments to perform accurate or precise operations or measurements.
   o. Use transducers to detect unusual odor, temperature and moisture situations.
   p. Traces circuit functions using pictorial representations.
   q. Use variable setting controls to change operational limits on equipment and machinery.
   r. Sets up, adjusts and calibrates machines and equipment to meet required specifications.

TROUBLESHOOTING continued:

s. Differentiate objects and details at normal working distance.
t. Disassemble and assemble equipment and machines to conduct necessary repair and maintenance.
u. Sets dials, gauges and lights using visual displays.
v. Interpret the condition of circuits using various measuring devices.
w. Test and trouble shoot electronic circuitry and sub-assembly for environmental defects.

	Competency Task		MATH*			PHYSICAL*				KEYBOARD*			COMMUN-ICATION SKILLS*			PHYSICAL SKILLS*										PERSONALITY SKILLS*									REFERENCES	COMMUNICATION REFERENCES
			GENERAL	ALGEBRA	GEOMETRY	MECHANICS	LIGHT	HEAT	GAS LAWS (vacuum)	TYPE	CALCULATE	TERMINAL	WRITTEN	VERBAL	READING	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1a	1b	1c	1d	1e	1f	1g	1h	1i		
ANALOG	RESISTIVE	* 1a	•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		* 1b	•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		* 1c	•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		1
		* 1d	•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	19	2
	DC—AC TRIGONOMETRY	* 2a	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		* 2b	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	28	3
	DC—AC PHASOR	3a	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	32	4
		3b	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	33	11
	FREQ. RESPONSE POWER	4a	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	46	13
		4b	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		14
		* 4c	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		15
	TEC. REPORTS	* 5a	•					•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		17
		* 5b	•					•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		23
	SKETCH	* 6a	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		27
		* 6b	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		29
	CONSTRUCT CIRCUITS	7a	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		* 7b	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		* 7c	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
	AUDIT	8a	•		•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
	QUALITY CONTROL	* 9a	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		* 9b	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		* 9c	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		* 9d	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
	ACTIVE CKT	* 10a	•		•			•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
	DEVICES	11a	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		11b	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
	POWER AND GROUND	12a	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		* 12b	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		12c	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		* 12d	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		

TROUBLESHOOTING																										Competency Task	
																				Troubleshoot and repair to insure proper system operation							
w	v	u	t	s	r	q	p	o	n	m	l	k	j	i	h	g	f	e	d	c	b	a			
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	GENERAL	MATH*
																								ALGEBRA	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			GEOMETRY	
•	•		•		•	•	•	•	•	•	•		•	•	•		•	•	•		•			MECHANICS	PHYSICAL*
		•	•	•	•		•		•	•	•	•	•	•	•	•	•	•	•	•				LIGHT	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			HEAT	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			GAS LAWS (vacuum)	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		TYPE	KEYBOARD*
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		CALCULATE	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		TERMINAL	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		WRITTEN	COMMUN-ICATION SKILLS*
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		VERBAL	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		READING	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			1a	PHYSICAL SKILLS*
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1b	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1c	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1d	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1e	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1f	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1g	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1h	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1i	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1j	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1a	PERSONALITY SKILLS*
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1b	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1c	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1d	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1e	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1f	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1g	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1h	
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		1i	
																								REFERENCES	
																								COMMUNICATION REFERENCES	

Competency Task			MATH*			PHYSICAL*				KEYBOARD*			COMMUN-ICATION SKILLS*			PHYSICAL SKILLS*										PERSONALITY SKILLS*									REFERENCES	COMMUNICATION REFERENCES
			GENERAL	ALGEBRA	GEOMETRY	MECHANICS	LIGHT	HEAT	GAS LAWS (vacuum)	TYPE	CALCULATE	TERMINAL	WRITTEN	VERBAL	READING	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1a	1b	1c	1d	1e	1f	1g	1h	1i		
HYGIENE	PERSONAL HYGIENE	* 1a	•				•			•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1b	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	18	
		* 1c	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	39	
		* 1d	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	43	
		* 1e	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1f	•				•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1g	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1h	•				•			•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1i	•				•			•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
		* 1j	•							•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		
	FACTORY HYGIENE	* 2a	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
		2b	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
		2c	•		•					•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
		2d	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
		2e	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
		2f	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•		
OPTICS	PHYSICAL	1a	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	GEOMETRIC	2a	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	24	
		2b	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	22	
		2c	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	21	
	LASER	3a	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	20	
		3b	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	46	
		3c	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		3d	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	FIBER	4a	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		4b	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
P.C.	CONTROLLERS	1a	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		1b	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	25	
	TROUBLE-SHOOT	2a	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	46	
		2b	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
PNEUMATIC CONTROLS	COMPONENTS & TROUBLE-SHOOT	1a	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	12	
		1b	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	40	
		1c	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		1d	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
HYDRAULIC CONTROLS	COMPONENTS & TROUBLE SHOOT	1a	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		1b	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	10	
		1c	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
		1d	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		

	Competency Task		MATH*			PHYSICAL*				KEYBOARD*			COMMUN-ICATION SKILLS*			PHYSICAL SKILLS*									PERSONALITY SKILLS*										
			GENERAL	ALGEBRA	GEOMETRY	MECHANICS	LIGHT	HEAT	GAS LAWS (vacuum)	TYPE	CALCULATE	TERMINAL	WRITTEN	VERBAL	READING	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1a	1b	1c	1d	1e	1f	1g	1h	1i	REFERENCES	COMMUNICATION REFERENCES
DIGITAL	COMBIN-ITORIAL	• 1a	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 1b	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 1c	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 1d	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	5	
	SEQUENTIAL	• 2a	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	6	
		• 2b	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	7	
		• 2c	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	8	
		• 2d	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	25	
		2e	•	•	•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	30	
	MICRO-PROCESSOR BASED	• 3a	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	31	
		• 3b	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	34	
		• 3c	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	42	
		• 3d	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	45	
		3e	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	46	
		3f	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
	PERIPHERAL	4a	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		4b	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
	TEST MEASURE	• 5a	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		• 5b	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
		5c	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•		
	PROGRAM-MING	• 6a	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 6b	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 6c	•		•					•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
SAFETY	SAFETY FOR WORKERS AND OTHERS	• 1a	•				•			•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 1b	•		•		•		•	•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		• 1c	•		•	•	•		•	•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	18	
		• 1d	•		•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	37	
		• 1e	•				•		•	•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	39	
		• 1f	•		•		•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	43	
		• 1g	•		•	•	•			•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	44	
		• 1h	•		•	•	•			•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		
		• 1i	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		1j	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		1k	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		
		1l	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		
		1m	•		•	•		•		•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		1n	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		
		1o	•		•	•				•	•	•	•	•	•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•		